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JOURNAL
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Volume XXXIX NOVEMBER, 1957 Number 4

FARM TECHNOLOGY AND THE RACE WITH POPULATION[1]

R. G. BRESSLER, JR.
University of California, Berkeley

DURING the past 30 years, population of the United States has increased about 45 percent and domestic utilization of agricultural commodities has increased some 60 percent. In spite of this great expansion, our farms have been able to meet the challenge with sharp increases in production—so successfully, in fact, that we have been troubled by agricultural surpluses during most of the postwar period. Will production keep pace with requirements in the future? Will agricultural productivity increase so rapidly that chronic surpluses continue? What should be our policies with regard to farm technology and increasing productivity? We will approach these questions by first considering more specifically the current balance between supply and utilization of farm products, and the trends during the past 30 years. We will then turn to the future, and summarize projections of population growth and requirements of farm products for the United States in 1975. This will give at least approximate measures of the production job ahead for our agricultural industry. Finally, we will consider the prospects for continuing increases in agricultural productivity, and the implications of this for research and extension work in agriculture.

Supply, Utilization, and Surplus of Farm Products, 1954-55[2]

In any given year, current utilization of food and fiber in the United States is the sum of domestic consumption (including military as well as civilian uses) plus exports to foreign countries and shipments to off-shore territories. In the same year, current supplies consist of the net production

[1] Giannini Foundation Paper No. 162, presented at the Annual Agricultural Staff Conference, Oregon State College, December 13, 1956.

[2] The statistics in this and the following section are taken mainly from *Measuring the Supply and Utilization of Farm Commodities*, Agricultural Handbook No. 91, Agricultural Marketing Service, U. S. Department of Agriculture, November, 1955.

of our farms plus imports from foreign countries and in-shipments from our territories. Discrepancies between utilization and supplies in any single year are normally adjusted through changes in stocks—in the amounts of farm products carried over from one year to the next. If utilization is less than current supplies, we have a *surplus* and so stocks are increased. If utilization exceeds supplies, the result is a *deficit* and a reduction in stocks.

The supply, utilization, and surplus situations for farm commodities in the United States during 1954 and 1955 are summarized in Table 1. These data are given in terms of values at the farm as measured in 1947-49 average dollars—physical quantities of agricultural commodities have been combined or weighted by applying average "at farm" prices for the 1947-49 period. In 1955 (but in terms of these 1947-49 dollars), the gross production of agriculture in the United States had a value "at the farm" of about $41.5 billion; more than $10.6 billion of this represented the value of feed and seed, however, so the "net" production of agriculture amounted to about $30.9 billion. Imports and in-shipments of agricultural commodities totaled $2.8 billion, divided almost evenly between supplementary imports such as sugar and apparel wool and complementary imports such as coffee and bananas. The annual available supply thus amounted to some $33.7 billion. In the same year domestic civilian use totaled about $28.7 billion, military use less than $0.5 billion, commer-

TABLE 1. SUPPLY, UTILIZATION, AND SURPLUS OF AGRICULTURAL COMMODITIES, UNITED STATES, 1954 AND 1955

Item	1954	1955
	Millions of dollars[a]	
Supply		
Crop production	20,217	21,246
Livestock production	19,586	20,247
Gross production	39,785	41,493
Less feed and seed	10,336	10,642
Net production	29,449	30,851
Commercial imports	2,614	2,837
Annual available supply	32,063	33,688
Utilization		
Domestic civilian use	27,471	28,736
Military use	552	499
Commercial exports	2,654	2,814
Annual commercial utilization	30,667	32,049
Surplus		
Annual commercial surplus	1,386	1,639

[a] In terms of 1947–1949 dollars; 1955 data are preliminary estimates.

cial exports $2.8 billion, and so total utilization was about $32.0 billion. This resulted in a surplus of more than $1.6 billion for the year. The situation in 1954 showed slightly lower supply and utilization totals, and an apparent surplus of about $1.4 billion (Table 1).

These calculated surpluses, equivalent to more than 5 percent of net production in 1955, somewhat understate the true situation. The data reported on commercial utilization include all products that moved through commercial channels, even though some of the sales were subsidized in any of a variety of ways and so were at least in part noncommercial. We know that such subsidized movements have been important in both domestic and foreign markets as part of the effort to dispose of growing surplus stocks. Secretary Benson, reporting early in 1956, made this quite clear:

> Our stocks of farm products have grown despite vigorous efforts to get rid of them . . . We have sold into the domestic market whenever we could do so without depressing prices of what farmers were trying to sell. We have donated vast quantities of food to our needy people. We have sold overseas for dollars wherever and whenever possible. We have sold for foreign currencies when we could not get dollars. We have bartered for strategic materials. We have donated to foreign countries whenever we could do so constructively. Surplus disposals by the Commodity Credit Corporation have risen from just over half a billion dollars in fiscal 1953 . . . to more than 2.1 billion dollars in fiscal 1955. Yet, aggressive as the disposal efforts have been, they have not kept pace with the problem. For each bushel equivalent sold, approximately one and a half have replaced it in the stockpile.[3]

Agricultural maladjustments are not measured alone by the apparent magnitude of the surplus, but also by acreage restrictions and control programs designed to reduce output as part of the price support effort. Unfortunately, we have no good basis for estimating the aggregate effects of control programs in reducing production or of subsidies in expanding utilization above commercial levels. For our purposes, however, it may be sufficient to point out that calculated commercial surpluses amounted to about 5 percent of net production in 1954 and 1955 but that real surpluses were somewhat larger—perhaps totaling 7 or 8 percent.

Any aggregate utilization and supply figures necessarily obscure the fact that surpluses are far more important in some lines of production than in others. A more detailed picture of the 1954 agricultural surplus situation is provided by the data in Table 2, where approximate surpluses are given for a number of farm commodity classifications. Because of limitations on available data, annual surpluses for 1954 have been defined

[3] Statement by Secretary of Agriculture Ezra Taft Benson before the Senate Committee on Agriculture and Forestry, January 12, 1956; U. S. Department of Agriculture Release, pp. 2-3.

in terms of the change in the total stocks during that year, and expressed as a percent of *gross* production. This procedure understates the magnitude of surpluses for reasons already discussed—the duplication of feed and seed accounts and the subsidized movement of commodities out of stocks. Nevertheless, the figures point out the categories where surpluses are most important problems. In crop production the major maladjustments are in the food and feed grains, in tobacco, cotton, and sugar. Livestock products show very slight surpluses, largely because these are perishable products and prices usually have been permitted to adjust to clear the market. Minor surpluses in the several livestock product classes were actually disposed of by U. S. Department of Agriculture purchases. Dairy products have figured most prominently in these programs, but even here the surplus amounted to only 1.4 percent in 1954.

Trends in Supply and Utilization Since 1924

We now turn from the details of the past year or two to the trends during the past 30 years. These are indicated in Figure 1, where annual

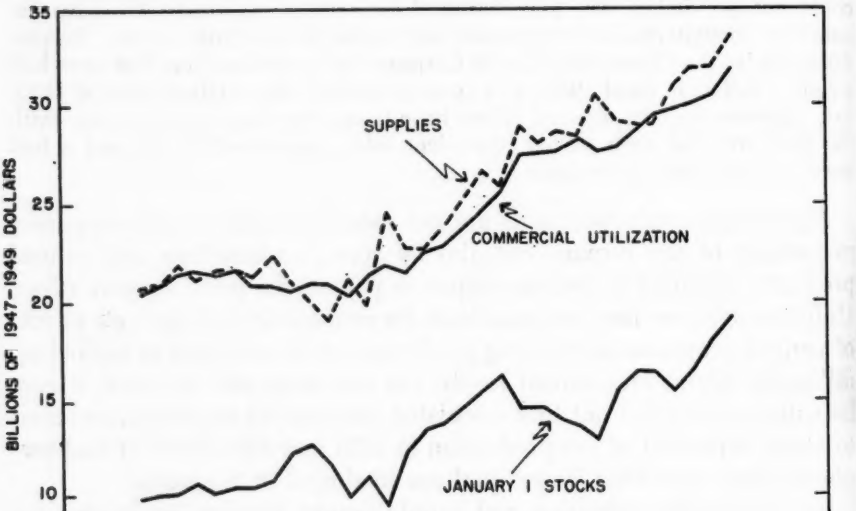

FIG. 1. Supply and Utilization of Farm Products, United States, 1924-55.

data on supply and utilization have been plotted by years from 1924 to 1955. Note that the indicated commercial utilization does not include U. S. Department of Agriculture purchases and that these were sizable and most important during the war and postwar periods. With this in

TABLE 2. GROSS AGRICULTURAL PRODUCTION AND PERCENT SURPLUS BY MAJOR FARM COMMODITY GROUPS, UNITED STATES 1954

Commodity group	Gross production	Percent surplus[a]
	million dollars[b]	
Crops		
Food Grains	2,338	14.8
Tobacco	1,018	13.0
Feed grains	6,583	9.6
Cotton	2,418	7.9
Sugar crops	223	5.4
All other	7,638	−0.5[c]
Total crop production	20,217	6.3
Livestock		
Dairy products	5,159	1.4
Animal fibers	115	0.9
Meat animals	9,519	0.3
Poultry and eggs	4,733	0.3
Total livestock production	19,586	0.6

[a] Change in stocks plus U. S. Department of Agriculture purchases expressed as percentage of indicated gross production.
[b] In terms of 1947–1949 dollars.
[c] Decrease in stocks, so this represents a deficit rather than a surplus.

mind, the diagram emphasizes that there have been rather persistent annual surpluses of farm products in the United States throughout this 30-year period. But the diagram illustrates other things as well. One is that surpluses have been relatively small in magnitude as compared with total supply or total utilization. Another is the erratic nature of both supply and utilization, the abrupt changes that can come from such developments as drought and war, and the consequent strategic importance of farm commodity reserves during such periods. This is further illustrated by the lower line in Figure 1 showing changes in January 1 stocks of farm commodities since 1924. Although the date of January 1 is not well designed to illustrate our present point because of the normally large stocks at this time of the year, yet we can observe an important tendency for stocks to increase during the period. Moreover, the increase in stocks has amounted to about 100 percent, while annual requirements have only increased by about 50 percent. These same data stress the rapid depletion of stocks during the 1934-36 drought period and during the war and immediate postwar years.

Finally, the data on supply and utilization show the marked increases in both series that have occurred. The increase in utilization was primarily a reflection of population increases, for U. S. population moved from about 114 million in 1924 to 165 million in 1955—an increase of 45 percent. Over the same period, per capita real income in the United States was increasing about 73 percent, and this brought an increase in per

capita consumption of farm products (in at-farm values) of more than 12 percent. The combined influence of population growth and increased per capita consumption was an increase of more than 60 percent in total domestic utilization.

Viewed from the perspective of these marked increases in the needs for farm products, the impressive aspect of agricultural output is not the relatively small surpluses but rather the ability of our farms to keep pace with consumption increases. The expansion of agricultural output has been vitally important to our nation, both in meeting rapidly expanding peacetime requirements and as a major contribution to the war effort. The rate of increase far exceeded any other comparable period, and its magnitude is especially impressive when it is realized that during this 30-year period there was little change in the acres of cropland harvested and a very substantial decrease in total agricultural labor. The summary statistics in Table 3 tell the story. Between 1924-29 and 1950-54, net agricultural production increased nearly 50 percent—the actual increase of 1955 over 1924 was 65 percent! During this period the index of cropland used remained approximately constant while the index of man-hours of farm labor dropped by one third. As a consequence of these changes, output per acre increased 45 percent while output per man-hour more than doubled.

TABLE 3. INDEX NUMBERS OF NET AGRICULTURAL PRODUCTION, CROPLAND USED, MAN-HOURS OF FARM LABOR, AND OUTPUT PER ACRE AND PER MAN-HOUR UNITED STATES, 1925–55, Averages for Five-Year Periods

Years	Index numbers, 1947–1949 = 100				
	Net agricultural production	Cropland used	Man-hours of farm labor	Production per acre	Production per man-hour
1925–1929	71	99	137	72	52
1930–1934	70	100	131	70	53
1935–1939	74	99	123	75	60
1940–1944	89	98	120	91	74
1945–1949	98	99	104	99	94
1950–1954	104	100	89	104	117

These increases in productivity are for the most part reflections of the development and spread of agricultural technology. Improved knowledge of plant and animal nutrition, better and more efficient plant and animal strains, improved controls for disease and pests, rapid expansions in farm mechanization—all contribute to the increase in net production per man and per acre. To this must be added efficiency in the selection of enterprises for the shift from less intensive to more intensive enterprises has also contributed largely to increasing aggregate yields.

We need not develop this point in detail for it is obvious to all familiar with United States agriculture. Between 1940 and 1955, the numbers of tractors and trucks on farms tripled while the numbers of such machines as combines, milking machines, and corn pickers increased four- to six-fold. This mechanization made it possible for one worker to handle a substantially larger acreage and to produce a correspondingly larger output. At the same time, the substitution of mechanical power for horsepower resulted in a decline in the numbers of horses and mules on farms—from nearly 27 million in 1918 to less than 5 million in 1955. This meant a substantial release of cropland from the production of feed for work stock and so was an important factor in the increase in the net production of agriculture for human consumption. The use of commercial fertilizers has more than tripled since prewar, and this plus improved plants —including such developments as hybrid corn—have resulted in substantially larger crop yields per acre. Average production of milk per cow has inceased more than 20 percent since 1940 while annual egg production per layer has gone up nearly 40 percent.

The Outlook for the Future—1975[4]

We have seen that the domestic utilization of farm commodities in the United States increased more than 60 percent during the past 30 years with about two-thirds of this increase reflecting population growth and the balance higher per capita consumption rates. On the other hand, we found that farm production more than kept abreast of needs and that increased output has apparently resulted from shifts in the intensity of use and from improved agricultural technology with nearly constant total cropland and a significant decline in the amount of farm labor. Supplies have actually exceeded requirements through most of the period, and surplus stocks have built up. These stocks have been very strategic reserves during the drought years, during World War II, and to some extent during the war in Korea. Current supplies are apparently running 7 or 8 percent above requirements, however, and the stockpile of agricultural surpluses has been increasing in spite of many efforts at production control and disposal in foreign and domestic outlets.

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[4] *Current Population Reports—Population Estimates,* Series P-25, No. 123, Bureau of the Census, U. S. Department of Commerce, October 20, 1955.

"The Long-Term Price Outlook and Its Impact on American Agriculture," Nathan Koffsky, *Journal of Farm Economics, Vol. XXXVI, No. 5,* December, 1954, pp. 790-798.

"The Long-run Demand for Farm Products," Rex F. Daly, *Agricultural Economics Research, Vol. VIII, No. 3,* July, 1956, pp. 73-91.

Farm Output—Past Changes and Projected Needs, Agricultural Information Bulletin No. 162, Agricultural Research Service, U. S. Department of Agriculture, August, 1956.

How will we fare in the future? Precise estimates of future trends in either supply or utilization are impossible, but we can make carefully conditioned projections or "guesses" that should be of considerable value as guides for the future. Let us consider trends in our requirements for agricultural products turning first to the major factor of population growth. We can say with assurance that our population will increase "materially" during the next 20 years, but what are the expected magnitudes? Twenty years ago demographers were agreed that U. S. population growth was slowing down and that we would have a stationary or slowly declining population long before the end of the century. But these projections were upset by the very rapid upsurge in population growth and birth rates during the war and postwar periods. Today we anticipate a continuation of a fairly rapid growth for at least some years. The U. S. Bureau of the Census has been making projections based on several alternative sets of assumptions as to birth rates, death rates, and migration, but the uncertainty of these projections is suggested by the spread between the several sets—ranging from 207 to 229 million in 1975—and by the fact that the whole series of projections has been revised upward on several recent occasions. If we accept an intermediate projection, however, it appears that U. S. population may increase some 35 percent during the next 20 years.

The aggregate productivity of our total economy has been increasing fairly rapidly during past years, and this has meant increases in real income and in living standards. If these productivity trends continue—undisturbed by wars and depressions—disposable real income per capita may increase by 40 to 60 percent during the next 20 years. Only a part of this increase will be used to buy farm products, and probably a lower proportion than in the past period, but perhaps per capita consumption of these products will increase by 8 percent.[5] With increased population and per capita consumption, the total domestic requirements for farm products might increase by 45 percent above 1955 levels. Expansion of export markets is possible, but it seems unlikely that normal exports will exceed the present partially subsidized levels.

These projected requirements for 1975 are compared with 1955 data in Table 4, where all values are expressed in index number points with *net agricultural production* in 1947-49 equal to 100. In these terms, the anticipated 45 percent increase in domestic utilization will mean an increase from 107 in 1955 to 156 in 1975. Commercial exports plus military

[5] This assumes a continuation of the shift to livestock products with increases in per capita income. In view of current agitation about the dietary intake of animal fats and proteins, this may prove to be the weakest point in the 1975 projections. Any substantial shift away from the livestock products, of course, will drastically change the supply–utilization balance.

shipments are assumed to remain constant at 13, so total utilization would increase from 120 in 1955 to 169 in 1975. The 1955 supply figures are 115 for net agricultural production plus 11 for commercial imports, or a total supply of 126. If commercial imports remain at the 1955 level, the net production of American agriculture will have to be increased to 158 in 1975 in order to meet the projected increase in requirements. This represents an increase of 43 index points in net production during the 20 year period.

TABLE 4. UTILIZATION AND SUPPLY OF AGRICULTURAL PRODUCTS IN 1955, AND PROJECTED UTILIZATION IN 1975, UNITED STATES

	Index numbers[a] 1947–1949 net production = 100	
	1955	1975
Civilian utilization	107	156
Exports and military	13	13
Total utilization	120	169
Net agricultural production	115	158[b]
Commercial imports	11	11
Total supply	126	169[c]
Apparent surplus	6	—

[a] All data are based on at-the-farm values, in terms of 1947–49 dollars, and converted to index number terms by taking net agricultural production in 1947–49 equal to 100.

[b] The projected increase if net production is to keep pace with increase in requirements; obtained by subtracting assumed imports from projected total utilization.

[c] Equal to total utilization, and not a projection of the total supply.

In considering this table, it should be emphasized that the 1975 values labeled supply are in no sense forecasts of production and imports. *Rather, these are indications of the increase in net production that must be attained if imports remain constant and if we are to meet the projected increases in utilization.* As mentioned above, this required increase would amount to some 43 index points *in addition to* the calculated surplus of 6 index points available in 1955.

The Job Ahead for Agriculture

Can American agriculture meet the challenge of this race with population and increased per capita consumption? As a first step in this consideration, examine the trends summarized in Figure 2. Here we have plotted index numbers of net agricultural production from 1924 to 1955 and also the projected requirements to be met from domestic production in 1975. Certainly this chart suggests a basis for confidence in our abilities to meet the production "goal" in 1975—the required increase is almost

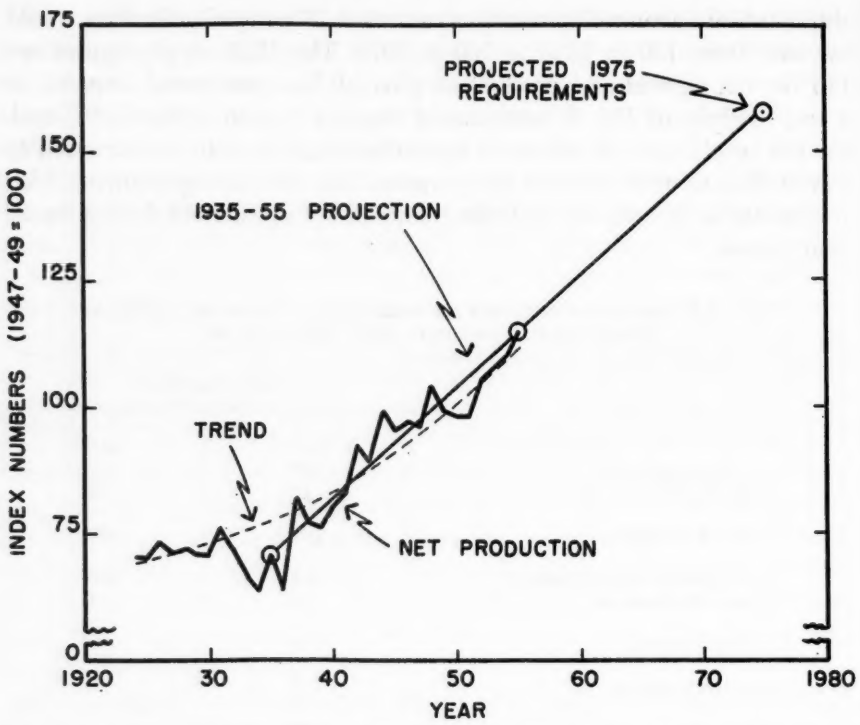

FIG. 2. Index Numbers of Net Agricultural Production, 1924-55, and Projected Requirements to be Met from Domestic Production in 1975, United States.

exactly equal to the actual increase in production achieved during the 20-year period from 1935 to 1955. Even when we recall that this particular period represented the most rapid expansion in farm output on record, the fact that we have been able to make such increases speaks well for our abilities to duplicate the feat in the future. The increase of 44 points in the index number from 1935 to 1955 certainly lends support to the belief that we can achieve the projected further increase of 43 points from 1955 to 1975.

These are several aspects of the 1935-55 and 1955-75 situations, however, that differ and require further exploration. One of the major differences relates to farm workstock and the source of farm power. In 1935, there were about 17 million horses and mules on farms in the United States, while by 1955 the number had been reduced to less than 5 million. This resulted from the substitution of tractors and trucks for workstock and of gasoline for farm-produced feed. The reduction in cropland required to produce feed for workstock during the 20-year period amounted to some 40 million acres. As is indicated in Figure 3, this factor

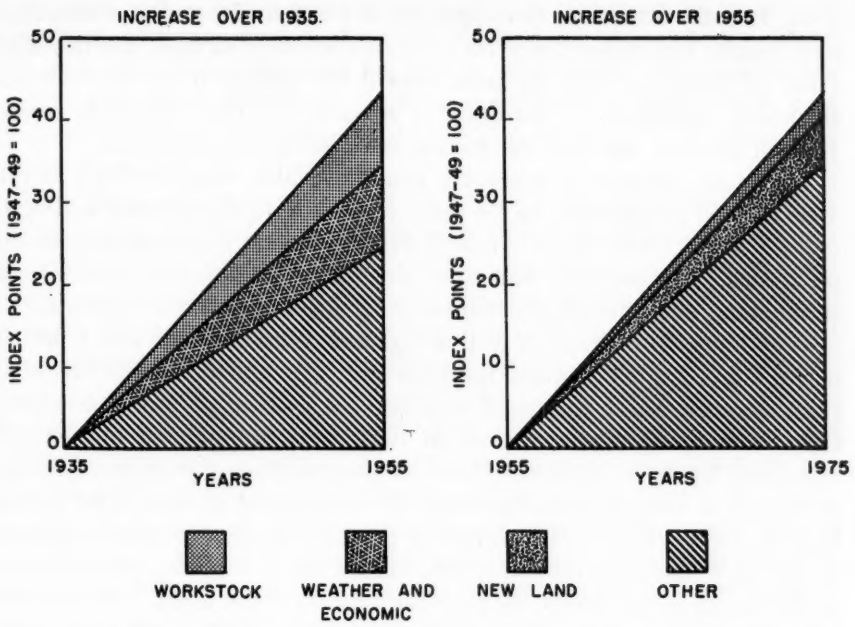

FIG. 3. Sources of Increased Farm Output 1935 to 1955, and Projected 1955 to 1975, United States.

alone accounted for 9 points out of the total 44-point increase in net agricultural production from 1935 to 1955. Most important is the fact that this is a nonrepetitive factor—we cannot expect a comparable situation during the next 20 years. The U. S. Department of Agriculture has estimated that the numbers of horses and mules on our farms may be reduced to 2 million in 1975 and that the 1955 to 1975 change will release about 6 million acres of cropland now used for feed production. This is a significant factor, to be sure, but it would amount to only 2 points out of the needed 43-point increase in net production between 1955 and 1975.

A second complex of nonrepetitive factors may be suggested by the net production index in Figure 2 and by our recollection of some historical facts about climate and economic activity. We note that 1935 production was relatively low—and we remember the drought conditions of the 1934-36 period. On the other hand, we know that the war years were generally characterized by unusually favorable weather and that the weather situation was generally favorable up to 1955. So far as the future is concerned, we must expect a mixture of favorable and unfavorable weather—we certainly cannot safely predict future production on the assumption that climatic conditions will become more and more favor-

able. To some extent our developments in plant strains and in mechanization reduce our dependence on favorable weather as does the development of irrigation. Still we must regard the change from the very unfavorable conditions of the drought years to the very favorable conditions of the war and postwar period as definitely nonrepetitive.

Important changes in economic conditions also were involved in the 1935 to 1955 comparison. In the early years, the whole economy and agriculture in particular were involved in the greatest economic depression on record. This certainly had some depressing influence on agricultural production, even though the tendency for farm output to be maintained during depression periods is well recognized. With the war came a period of rapidly advancing prices for farm products and of record levels of farm incomes. These continued well into the postwar period. Net income from farming hit a record peak in 1947, then dropped off but largely recovered by 1951, and since then has been declining. In spite of recent pressures on farm income, however, the situation at present is far better than in 1935, and the 1955 levels of production are undeniably related to the very favorable economic situation in the intervening years. So far as the future is concerned, we may hope for favorable conditions, and the projections of requirements have been based on an assumption of prosperity. But we can hardly plan on the price and income incentives that have accompanied the recovery from the Great Depression of the 1930's and the war situation of the 1940's.

Another aspect of the economic situation is significant in this discussion and that has to do with the application of farm technology. With the agricultural depression of the 1920's and the total depression of the 1930's, farmers were neither in the psychological nor the financial position in 1935 to adopt many of the technological innovations that were then available. As a result, we entered the 1935-55 period with a large backlog of developed technology that had not been generally applied. With rapidly improving prices and incomes, our farmers took full advantage of the opportunities for increased productivity through the application of technology. We have already mentioned some of the changes that resulted —the rapid increase in farm mechanization, in the use of fertilizers, and in better plant and animal strains. Today we also have a significant backlog of unutilized technology—we know how to farm better than we are farming—but it seems very doubtful if the unutilized backlog as we start the 1955-75 period is of anything like the magnitude of the backlog at the start of the 1935-55 period.

We can recognize that weather, economic conditions, and the backlog of technology are nonrepetitive factors that contributed to the 1935-55 increase in farm production and that cannot be expected to make similar

contributions in 1955-75, but it is difficult to estimate the magnitude of this effect. As a very crude approximation, we have compared the actual change from 1935 to 1955 with the change represented by a more-or-less smoothed trend of production. Figure 3 indicates that these factors may have accounted for 10 points of the 1935-55 increase—10 points that cannot be depended on in 1955-75.

With these adjustments the comparison between the 1935-55 accomplishment and the 1955-75 requirements gives little basis for complacency. After eliminating the effects of the decline in workstock and of nonrepetitive factors, the remaining increase for the first 20-year period amounted to about 25 index points. For the future period, however, the adjusted requirement is 41 points. Some assistance in meeting the 1975 goal may come from expansion in the acres of cropland harvested. We have noted that this was nearly constant from 1925 to 1955, but land economists have estimated that a net increase of as much as 25 million acres might be brought into cultivation during the next 20 years. This would be equivalent to an increase of about 6 percent of total harvested acres and so would lower the increases needed from technology and yields to 35 points. In summary, then, it would appear that the real job ahead for American agriculture is not simply equivalent to the remarkable increases achieved during the past 20 years but 40 percent higher than those record rates.

Technological Advance and Research

It is not our purpose to suggest that the citizens of the United States will go hungry in 1975. The previous projections of future requirements have been based on the assumptions of peace, prosperity, and relatively stable prices. If agricultural output should lag somewhat below the estimated requirements, there would be some tendency for the prices of farm products to increase relative to other prices. This would mean a minor reduction in per-capita consumption rates, but it also would encourage other types of adjustments. Agricultural imports and exports have been projected to 1975 at present levels, roughly equivalent to 10 percent of present net agricultural production. With some shifts in farm enterprises, it would be relatively simple to reduce our exports if needed in the domestic market. At the same time, increasing farm product prices would attract larger volumes of imports, and if these imports were needed they could be encouraged by relaxing existing import barriers. Finally, the net amount of human food available could be increased significantly by relatively minor shifts away from animals foods and back to vegetable and cereal products—a relatively easy adjustment when it is realized that the 1975 projections assume further increases in our already relatively high proportion of animal foods in the diet.

Nor is it the purpose of this paper to suggest that United States agriculture will not be able to meet the projected needs. These projections indicate an increase in net agricultural production during the next 20 years approximately equal to the record breaking increases of the past 20 years. Because of nonrepetitive factors such as the replacement of horses by tractors, the production job ahead is perhaps 40 percent greater than the achievements of the past 20 years. But technological advance is the outstanding characteristic of our economy, and the agricultural sector is certainly participating in this advance.

We have already indicated that a relatively small increase in future net output can be expected from the further replacement of horses and from the development of new land. As a matter of fact, substantial increases in farm product prices might well bring back into cultivation lands in the Atlantic States that have reverted to grazing and forest uses during the past century. Improvements in crops and in the efficiency of livestock feeding will continue. The control of pests and diseases is an unending struggle, but with research developments we can anticipate continued and improved success in these areas. The development of more irrigated land in the arid regions will expand output, and the rapid increase in supplementary irrigation in the more humid sections can be expected to have a substantial impact on yields. Fertilizer application has yet to be exploited to the economic point for many crops and in important regions.

The real purpose of this paper, then, is to give a true perspective of the production job ahead for agriculture and the critical importance of technical improvements. The application of known technology at the farm will require effective educational work, and this will be a real challenge for agricultural extension workers. But application must be preceded by development and innovation—by research in the experiment stations and by private corporations. There is a backlog of technical knowledge that can and will be exploited, but this backlog must be continuously replenished if we are to sustain an increasing rate of expansion in our farm production. The base for our future increases in farm production, it must be re-emphasized, cannot be in expanded area under cultivation but from improved technology and ever-increasing yields per acre and per animal unit—and this can be possible only with expanding emphasis on research and educational activities.

Current farm surpluses, although only amounting to 7 or 8 percent in the aggregate, certainly represent an important problem, and there is no basis for believing that these will be absorbed by population growth and increasing normal demands in the immediate future. Mounting stocks in government storage have underlined the difficulties involved in public

programs and policies that attempt to maintain prices and incomes at levels that stimulate production beyond normal market requirements. The result has been increasing pressure for temporary solutions—through acreage and production restrictions on the supply side and through promotion and subsidization to increase foreign and domestic disposal.

Basically, the maladjustment in American agriculture is one of the allocation of resources—between agricultural and nonagricultural sectors as well as among alternative enterprises within agriculture. From this point of view, many of the current programs attempt to solve the farm problem by attacking price and surplus "symptoms" rather than attacking the fundamental problem. Whether or not these "symptom" programs can be justified depends primarily on the temporal nature of the surplus problem. If surpluses are essentially a temporary phenomenon of expected short-time duration, then such programs have considerable merit in that they contribute to immediate solutions while maintaining the agricultural productive plant in readiness for future use. If the maladjustment seems long term in nature, then fundamental shifts in resource use are needed. Our analysis suggests that the aggregate resource allocation to agriculture is not out of line in terms of the record-breaking outputs needed for the future. On the other hand, resource allocations within agriculture are certainly needed and should not be deferred by temporary programs and policies.

The pressure of surpluses has recently led to the suggestion that technological advance in agriculture should be curtailed for this would slow the rate of increase in productivity and so permit the absorption of surpluses within a relatively short time. One aspect of this suggestion is the proposal that agricultural research and extension activities be limited to "cost-reducing" technology, and that "output-expanding" technology be avoided. Entirely aside from the fact that most cost-reducing adjustments release resources for other farm employments, and so in the aggregate must be output expanding, this proposal appears to be overly influenced by the immediate surplus situation.

If our analysis of future requirements is correct, agriculture is faced with a production and productivity problem for the next 20 years that far exceeds any accomplishments of the past. That this challenge can be met is not denied, but to suppose that such impressive advances can be accomplished and sustained—not only in the next two decades but to an increasing extent in the years beyond 1975—without continuing and substantial contributions in agricultural research and extension activities seems entirely unwarranted. To follow this path would mean to gamble with our future in the hope of solving problems that have been stimulated if not created by past programs and policies. Agriculture can con-

tinue to make great advances in efficiency and productivity and so contribute substantially to the growth and development of the total economy, but agriculture cannot be expected to maintain and increase past trends in efficiency and productivity unless supplied with a continuing stream of new technological innovations—a stream that must originate in research and be disseminated through education.

FARM INCOME AND THE SUPPLY OF AGRICULTURAL PRODUCTS[1]

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THE presumption that the supply of farm products may persistently increase with declining farm prices is accepted by some makers of agricultural policy[2] and is flatly rejected by other important makers of farm policy. This situation points up our meager knowledge about the supply of farm products. In recognition of this state, agricultural economists have recently been devoting more attention to the subject of supply; or at least they have been publishing more about this important area. The study of supply is important since supply is an important factor in the determination of price and of farm income. Such study is also important for the light it can throw on the agricultural adjustment problem.

The belief that the supply curve for agricultural products is backward sloping for at least part of its length has not been clearly defined in a way that permits one to see its implications. This is also true of the related idea that farm income belongs in a study of the supply of agricultural products.[3] Since these ideas do have some current acceptance, it seems worthwhile to explore the possible bases for them. This article attempts to specify the conditions under which each of these hypotheses is valid.

Technological progress is one reason why we sometimes observe a larger output at a given price than we previously observed at a higher price. In order to get at certain basic points, technology will be assumed constant in the following analysis.

Some people apparently feel that the assumption of a backward-sloping supply curve for farm labor is sufficient to justify the inclusion of income in a study of agricultural supply.[4] However, a moment's reflec-

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[1] Journal Paper No. J-3168 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 1318. I am indebted to Don Kaldor, Ernest Feder, Paul Kelley and Eddie Easley for their helpful comments on an earlier draft of this paper. The word supply seems to have fallen into ill repute in connection with the study of agricultural production, for what reasons I am not quite sure. Presumably when we analyze $q_s = F(p)$ we are studying supply, but when we analyze $q_s = f(p, x_1, \ldots, x_n)$ we are no longer studying supply but output or output response. In this paper, the analysis of either one will be referred to as the study of supply.

[2] Helen C. Farnsworth and William O. Jones, "Response of Wheat Growers to Price Changes: Appropriate or Perverse?" *The Economic Journal*, Vol. 46, June 1956, pp. 271-87. This article is an interesting refutation of an earlier study which had concluded that there is a negatively sloped supply curve for wheat in western Canada.

[3] F. M. Schrader, *Factors Affecting Hog Production*, Canada Department of Agriculture, Marketing Service, Economics Division, Ottawa, 1953. He uses income as an independent variable in a regression analysis of hog production.

[4] Schrader, *Ibid.* justifies its inclusion on these grounds.

tion shows that this need not be the case. If a negative relationship between income and the supply of agricultural labor justifies the inclusion of income, a positive relationship also justifies its inclusion. The validity of including income does not depend on the sign of the relationship but only on the existence of the relationship.

The Kinked Supply Function

Clodius has presented his reasons for including farm income in a study of the supply of agricultural products.[5] He represents the short-run supply function for a single farm commodity in a graph like Figure 1. During

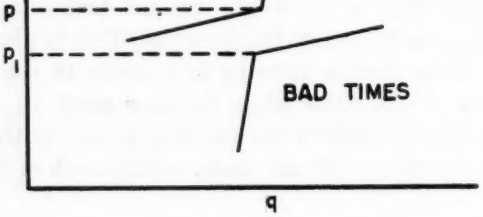

FIG. 1

periods of agricultural prosperity the response to a price increase above the prevailing level, P, is inelastic (1) because of the importance of leisure when monetary income is at a high level and (2) because of uncertainty concerning the duration of the higher price. The response to a price decrease is elastic because the farm operator shifts to other products with higher prices in order to maintain his income at this high level.

During bad times the response to a price increase above the prevailing level, P_1, is elastic because the farmer's desire to increase his income leads to sharply increased production. Because of the uncertain duration of relative price relationships and the expense of changing to new production, however, the farmer reduces output but little in response to a price decrease.

There appears to be an awkward lack of symmetry in his argument. If the firm can respond to a lower price for one product by shifting resources to other products during periods of good times, it can respond

[5] "The Theory of the Kinked Output Path Response," *Journal of Farm Economics*, Vol. 35, August 1953, pp. 427-36.

to a higher price by shifting resources away from other products *without* sacrificing much in the way of leisure. So one reason for the existence of the kink during good times disappears. Another reason advanced for the existence of this kink is the uncertainty regarding the duration of the price increase. This uncertainty inhibits the response to the price change. But uncertainty must also exist concerning the duration of the price decrease. This uncertainty would tend to make it not worthwhile to shift resources away from this product to the relatively higher priced products. During bad times, Clodius argues, the situation is just the reverse: uncertainty affects the reaction to a price decrease but not to a price increase. Will not the expense of changing to new production inhibit the response to a price increase as well as to a price decrease?

It would seem more reasonable to me to believe that there is uncertainty concerning the duration of price movements in both directions. I find it hard to accept one-way uncertainty as one reason for a kink, especially when the one-way uncertainty takes one direction during good times and another direction during bad times. If the kinks do not exist, Clodius' "good-times" and "bad-times" supply curves presumably merge into one curve and the need for considering income no longer exists. Since his arguments do not seem satisfactory, it is necessary to look elsewhere in search of justification for the inclusion of income in a supply study.[6] The next two sections set a framework for this further exploration.

Measurement of the Relevant Operator's Income and Wage Rate

According to our accepted theory of the firm, we can conceive of the returns to the operator and his family as consisting of four parts: (1) fixed wages of routine management, (2) entrepreneurial profits, (3) variable returns to the labor of the operator and his family and (4) net returns to operator-owned, variable and fixed, nonlabor inputs. Micro-theory usually assumes that the entrepreneur attempts to maximize entrepreneurial profits, which are a residual return. The others are treated as implicit or noncash costs of production and are compared with opportunity costs in determining resource allocation.

In the determination of the operator's labor income and wage rate, the appropriate measure appears to be the sum of (1), (2) and (3). That is, the operator decides the amount of his available labor to put into agriculture on the basis of this sum. Items (1) and (2) constitute returns to management and obviously must be considered together. These must be

[6] If farmers form price expectations on the basis of the relation between present prices and subjectively determined normal prices, Clodius' kinks may exist when prices reach "abnormally" high or low levels. Even if true, this does not furnish a reason for including income in the analysis of supply. The immediate reason for the kinks is the existence of high or low prices, not the existence of high or low incomes.

considered with item (3), since a decision to utilize his management abilities in agriculture is also a decision to utilize (at least some of) his family labor in agriculture, and vice versa. He cannot allocate management to farming without also devoting family labor to farming.[7] He cannot devote family labor to his farm operations without devoting managerial abilities to the farm operations.

This does not seem to be quite satisfactory because, in general, an operator's decision to commit or not to commit labor and management to a farm's operation is also a decision to commit or not to commit operator-owned nonlabor inputs, and vice versa. If this is the case we are faced with a problem of joint allocation in which human resources, land and capital must be allocated in a lump and the total returns to all three must be considered in order to determine how any one (and consequently all three) will be allocated. This is perhaps a more satisfactory basis for studying short-run than long-run problems. In the short run the operator cannot commit his labor to agriculture and all of his capital to other enterprises[8] because this would require a change in the form of at least some of his capital from fixed to circulating, which is a long-run operation. In the long run, however, he might sell his land and capital, invest the sales proceeds in stocks or bonds and work as a hired farm laborer. This long-run operation might be accomplished in a relatively short span of time, certainly less than a year. Even in the short run he might commit his land and capital to farm production through a partnership, or a leasing or share arrangement, and devote his labor to off-farm employment. Of course, at any particular time, an operator may have some capital invested in agriculture, some invested outside of agriculture and some—his funds for current transactions—not invested at all. Since it is possible for an operator to allocate his entrepreneurship and labor separately from his land and capital, the appropriate returns to use in determining the operator's labor income and wage rate are the sum of (1), (2) and (3).

A Work-Income Preference System

The work-income preference system drawn in Figure 2 implies that at low income levels, more labor is forthcoming in response to increases in wage rates while at higher income levels, the worker divides an increase

[7] This is not true, of course, in the rare instances in which the owner devotes all his energies to management and hires all the labor inputs. Since this is the uncommon case, it will receive no more attention here. This presentation does not exclude the possibility of devoting some of his human resources to farm employment and some to nonfarm employment.

[8] Except in rare circumstances in which he would leave these latter two idle and put himself out for hire or would leave these idle and rent land and capital from someone else.

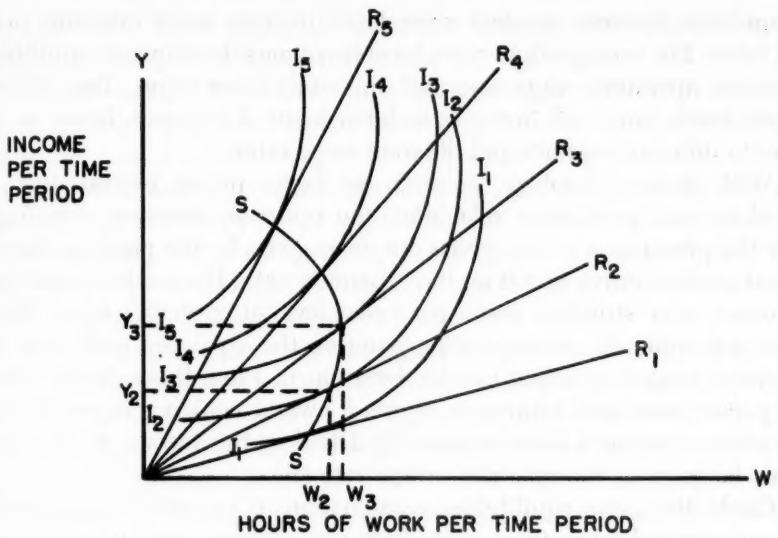

FIG. 2

in the wage rate between leisure and income. This preference system is sometimes presented as being typical of that existing for labor and S-S is presented as supply curve for labor.[9] Each I_1-I_1 curve connects all combinations of work and income that give the same level of satisfaction. Higher values of the subscript represent higher levels of satisfaction. R_1 represents a particular wage rate, higher values of the subscript representing higher wage rates.

Computation of the Operator's Wage Rate

For present purposes, where we want to relate the income effect of changing product prices to the supply of labor by the farm operator and his family (operator's labor for short) there must be some way of relating the price level of the product to the amount of labor input. In order to use Figure 2 for this purpose there must be a unique one-to-one corre-

[9] Carroll R. and Marion R. Daugherty, *Principles of Political Economy* (Boston: Houghton Mifflin Co., 1950, 2 vols.) Vol. 1, pp. 173-179, 231-235. Clodius, *Ibid.* p. 432, presents a leisure-income preference schedule representing the same ideas. D. Gale Johnson, "The Supply Function for Agricultural Products," *The American Economic Review*, Vol. 40, Sept. 1950, pp. 543-544 writes "The explanation that agricultural output is maintained (or even increased) by farmers as a means of offsetting lower prices may have a certain validity. Over certain ranges, the supply curve of operator and unpaid family labor may be backward sloping; i.e., individuals work more at a lower than a higher wage. This statement implies that as income falls, the marginal utility of income increases relative to the marginal utility of leisure." As a matter of personal convenience, I plot work and income, although it is conventional to plot leisure and income.

spondence between product price level, income, wage rate and supply of labor. For each product price level there must be only one equilibrium income, operator's wage rate and operator's labor input. Two different price levels can result in the same labor input. They must, however, give rise to different incomes and different wage rates.

With given technology, product and factor prices, capital stock and work-income preference schedules, the optimum resource combination for the production of any given output is given by the point on the constant product curve that is on the expansion path. If we select a particular product price structure and a particular level of operator's labor (W) we can determine the corresponding point on the expansion path. The total revenue from this output can be determined. From this subtract all out-of-pocket costs and returns to operator-owned nonlabor inputs in order to obtain operator's labor income (Y). Dividing this income by the operator's labor gives the operator's wage rate (R).

Could the same equilibrium combination of operator's labor income, wage rate and labor input arise from two different product price levels (with relative product prices unchanged)? This would happen if the same amount of operator's labor were used in earning a given amount of labor income with the two different price levels. This would require that the firm be operating at a nonoptimum point at the higher product price level. If a given amount of labor earns a given labor income at the lower price level it could be used to produce a larger labor income at the higher price level.

Suppose, however, the larger labor income was earned at the higher price level but was exactly offset by a smaller return to firm-owned nonlabor resources. The net income, which is the sum of items (1), (2), (3) and (4), would be the same in the two situations. Then the fact that the operator did not earn the higher labor income at the higher price would not necessarily mean inefficient operations at that price level. For the net income to be the same from the two different operations at the higher price level, it would be necessary that the operation which yielded the larger operator's labor income also increased the expenditures on purchased resources by exactly the same amount that it increased total revenue. In other words, at the higher price level there must be two distinct operations which use the same amount of operator's labor and between which the operator is indifferent because they yield the same net income. This is a case of multiple equilibria. We normally think of production functions as giving unique equilibria such that movement away from equilibrium continuously increases costs more than revenues, but multiple equilibria cannot be rejected a priori. These multiple equilibria have two special characteristics: (1) they are achieved with a con-

stant operator's labor input; (2) their net revenues are equal. It seems quite likely that such situations would be extremely rare.

The same equilibrium combination of operator's labor income, input and wage rate would arise in this instance of special multiple equilibria and in the case of inefficient operations at the higher product price level. If we suppose that these situations do not typically prevail, we can use Figure 2 and have each R_1 correspond to a particular product price (or set of product prices if we assume percentage changes in product prices to be perfectly correlated). The R_1 need not be straight lines. For convenience they will be assumed to be linear here.

If there are variations in relative product prices, there will presumably be reallocation of resources among products. Then a given level of farm prices (as measured by a price index) might induce the same operator wage rate from two different combinations of labor income and labor inputs. In this situation, however, the variation in labor input with a given wage rate cannot be explained by reference to variations in income. It can only be explained by reference to the structure of the price index.

Opportunity Cost

The opportunity cost to the operator and his family of retaining their labor in agriculture is the income they could earn by devoting this labor to some other pursuit. Could not a person justify the use of farm income (actually farm labor income) as a variable to be compared with the opportunity cost of farm employment, namely nonfarm income?

There is a one-to-one correspondence between nonfarm wage rate, income and level of satisfaction and a one-to-one correspondence between farm wage rate, income and level of satisfaction. Hence, we may use either wage rates or incomes; each gives us the same information as the other, no more, no less. Obviously, whether a person uses income or wage rate, he must include that same one for both farm and nonfarm employment.

A Shift in the Preference System

We would need to consider income in those situations in which a given operator wage rate calls forth different amounts of family labor under different circumstances. A passage, previously referred to, in Daugherty and Daugherty[10] suggests what these circumstances are: the enjoyment by the farm family of a new high level of living. The work-income preference system shifts upward each time the family becomes accustomed to a new high level of real income and the level of living that real income carries with it. This means that a familys' level of satisfaction from a given

[10] *Ibid.*

combination of leisure and income (or work and income) is not invariant wtih respect to experienced levels of income. Rather, over time the utility a person derives from a given real income (amount of work held constant) declines as he becomes accustomed to higher levels of real income.

In Figure 3, let the solid II curves show one work-income preference

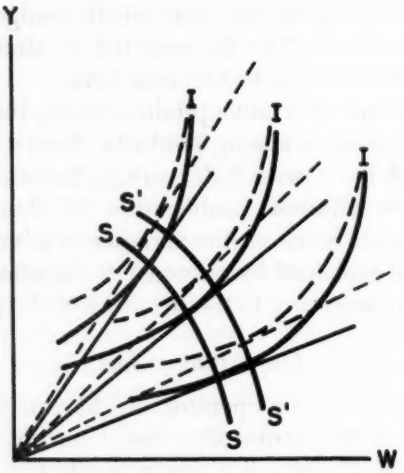

FIG. 3

system and the broken curves show the system existing after a vertical upward shift in the system, this shift being brought about by the family's becoming accustomed to a new peak level of real income and level of living. This shift results in every point on a particular II curve moving upward along the Y axis by the same amount. The family's labor supply curve will shift from SS to S'S', meaning that a given wage rate will induce a larger labor input now than previously. This argument, then, could be one basis for including income in a study of supply; the amount of labor the operator's family is willing to put into the enterprise in any time period is a function of the prevailing operator's wage rate and the highest previous income to which the famly has become accustomed. With a given preference system, labor income—the sum of items (1), (2) and (3) discussed previously—determines the volume of labor inputs. However, the pertinent income in considering shifts in the labor supply curve is total operator's income.

Note that this dependence of the volume of operator's labor inputs upon previous income holds whether this labor supply curve is positively or negatively sloped; but the effect on the supply curve does depend on the sign of the supply curve. If negatively sloped, the curve shifts to the right; if positively sloped, it shifts to the left.

The function that expresses the family's level of satisfaction as depending up the levels of work and income can be written as

$$S = \phi(Y, W) = .$$

$$\frac{\partial \phi}{}$$

Then

$$\frac{dY}{dW} = -\frac{\frac{\partial W}{\partial \phi}}{\frac{}{\partial Y}}.$$

That is, the marginal rate of substitution of income for work (dY/dW) equals the negative of the ratio between the marginal disutility of work ($\partial\phi/\partial W$) and marginal utility of income ($\partial\phi/\partial Y$).

If we make the conventional assumption that the operator attempts to maximize profits, we cannot have a shifting labor supply curve even though the preference system shifts upward. Scitovsky has shown that the assumption of profit maximization implies a constant marginal utility of income.[11] Since we can reasonably suppose that $\partial\phi/\partial W$ is a constant for given W, it follows from the assumption of profit maximization that dY/dW is constant for all Y for any fixed W. Graphically this means that each II curve is an exact vertical displacement of the ones below it. In this case, vertical shifts in the preference system will cause no change in the labor supply curve since the shape and position of the indifference curve brought into tangency with a particular R line by the shift will be exactly the same as the shape and position of the curve that was tangent to it before the shift.

If the indifference curves also change shape as they shift upward, the supply curve can shift even though $\partial\phi/\partial Y$ is constant with a fixed preference system. Whether they change shape or not, we can obtain a shift in the labor supply curve if we replace the assumption of profit maximization by the assumption that the entrepreneur maximizes some combination of leisure (or work) and income.

Declining marginal utility of income is not sufficient to establish a backward-sloping labor supply curve.[12] Declining marginal utility of income is consistent with either a forward- or backward-sloping supply curve. To see this, refer to Figure 4 and suppose again that $\partial\phi/\partial W$ is

[11] "A Note on Profit Maximization and its Implications," George J. Stigler and Kenneth E. Boulding (eds.), *Readings in Price Theory* (Chicago: Richard D. Irwin, Inc., 1952), pp. 352-358. Reprinted from *The Review of Economic Studies*, Vol. 11, 1943, pp. 57-60.

[12] Lionel Robbins, "On the Elasticity of Demand for Income in Terms of Effort," W. Fellner and B. F. Haley (eds.), *Readings in the Theory of Income Distribution* (Philadelphia: The Blakiston Co., 1949), pp. 237-244. Reprinted from *Economica*, Vol. 10, June 1930, pp. 123-129.

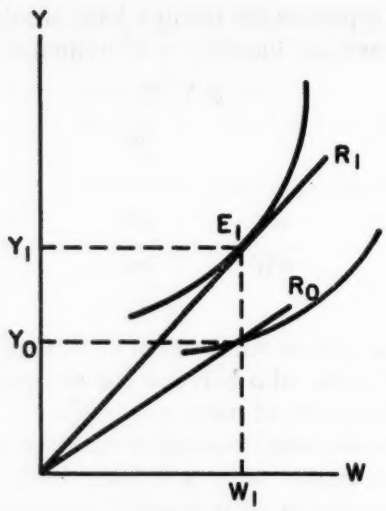

FIG. 4

fixed for given W. Starting from equilibrium point E_1 and wage rate R_1, the existence of a backward- or forward-sloping supply curve depends upon whether the equilibrium point at Y_0 is to the right or left of line E_1W_1. As we move down along E_1W_1 the slopes of successive II curves are declining since the marginal utility of income increases as income decreases, but the slopes of successive R lines are also declining. If the two decline at the same rate, the supply curve is vertical.

What must we specify in order to obtain a negatively sloped curve? We must specify that the slopes of successive R lines are declining more slowly than the slopes of successive indifference curves. Then the slope of the II curve passing through the intersection of E_1W_1 and R_0 is less than the slope of R_0. This II curve is then tangent to a wage rate line that is flatter than R_0, and this tangency occurs to right of the line E_1W_1. The existence of an operator's labor supply curve that is backward-sloping requires a particular relation between the slopes of successive II curves and the slopes of successive R lines. To use Robbins's terminology, the slope of the supply curve depends upon the elasticity of demand for income in terms of effort.[13] This is an empirical construct and its value cannot be determined from theoretical arguments any more than can the elasticity of demand for hamburger.

Backward-Sloping Product Supply Function

Consider a single enterprise farm or a multiple enterprise farm on

[13] Robbins, *Ibid.*

which the percentage changes in product prices are perfectly correlated. Assume constant technology, constant prices for all purchased inputs and falling product prices. A fall in the operator's wage rate brings about a decline in his labor income and a rise in his labor offerings, on the supposition of a supply curve that is backward sloping. This decline in the wage rate can be treated in the same way as a decline in any other factor price. This wage rate is the opportunity cost of leisure and this cost is falling; a lower wage rate draws more labor away from leisure and makes it available for substitution for other resources.

The lowest-cost combination of inputs to produce a given output occurs where the ratio between the price of a factor and its marginal productivity is the same for all factors. This ratio is equal to marginal cost and these optimum combinations are given by the expansion path. With a falling wage rate it is worthwhile to substitute labor for purchased resources. Therefore, the farmer can reduce his purchases of inputs, but he can increase his labor inputs to compensate for their withdrawal. As we reduce the input of purchased resources and increase the input of operator labor along a constant-product curve, the marginal productivity of purchased resources will rise. This will reduce the marginal cost of producing any given output and the product supply curve will shift to the right.

This shifting factor-price ratio would also occur even if the labor supply curves were forward sloping. In this case, however, the additional labor would not be forthcoming from the operator's family since they are reducing their labor input.

Let us consider the range through which substitution is possible. The substitution of the operator's labor for hired labor would be a relatively simple matter. Possibly labor could be substituted for other purchased resources only within certain ranges, however, outside of these ranges the constant-product curves being nearly parallel with the axes. If this range within which substitution can be easily accomplished is relatively wide, the supply function may be backward sloping through a wide range of product prices. If it is narrow, the supply function may be backward sloping through a narrow range of product prices and be virtually vertical at lower prices.

What about the inputs of the operator-owned nonhuman resources? Many of these are specialized fixed resources—land, buildings, machinery—and their direction into or out of agriculture will depend on the expected returns in agriculture and the opportunity cost of keeping them in agriculture. Since they are specialized we can safely suppose that the opportunity cost of keeping them in agriculture is virtually zero. In the short run we can treat these factors as free goods and their use will be determined by the nature of the firm's production function, the work-income pref-

erence system, the prices of products and the prices of purchased resources.

Suppose that in Figure 5, v_1 is a fixed, specialized, firm-owned resource and v_2 is a purchased resource. Suppose further that v_1 is divisible, e.g., its flow of services can be measured in hours of use, cubic feet used, or acres used. The optimum point is attained where the slope of a constant-product curve equals the negative of the price ratio, where the price for the fixed factor must be taken as the repair and maintenance costs. Suppose that during a period of high income this ratio is given by line P_aP_a

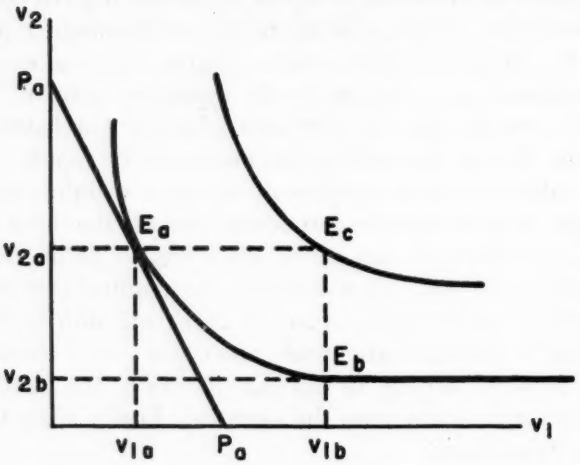

FIG. 5

where all these costs are being met. Then equilibrium is at point E_a. During a period of low income the operator can choose to postpone these costs of using v_1. For example, he can cease his practices of soil conservation and soil maintenance and "mine" the land. Then, temporarily, the effective price of v_1 is zero and the price line becomes a horizontal line; the operator will move from E_a to E_b (assuming he maintains production) and thereby substitute v_1 for v_2 even though there has been no change in the prices he pays for inputs.

By so doing, he reduces the present expenditures on producing the given output. If he maintains the same expenditures on v_2, and utilizes v_{1b}, he can increase production to E_c. This procedure involves an intertemporal substitution of income.

In addition to his human resources and his fixed resources, the operator owns some circulating capital in the form of livestock, feeds and seeds at the beginning of his production period. Consider a product in whose production the farmer can use circulating capital and purchased resources.

In determining what combination to use to produce a given product at lowest cost, the appropriate price to apply to the circulating capital is the revenue foregone by not using the resources in alternative uses. Since all product prices are assumed to fall proportionately, the opportunity cost of using the resource in any particular enterprise is falling, which means that the price line is rotating in such a way that more of this input and fewer purchased inputs will be used in producing a given quantity of output. In general, the opportunity cost of using any one of these items of circulating capital in the production of any one product will fall as product prices fall, and some purchased resources will be replaced by them. This conclusion also applies to fixed capital since the allocation of fixed capital among enterprises will be determined by opportunity costs.

Each time the operator substitutes a home-owned resource—labor, land, fixed or circulating capital—in response to a decline in the price of the home-owned resource, the marginal cost curve is lowered and the supply curve is shifted to the right. A declining marginal cost, however, is not sufficient to assure a negative relationship between price and output. In order for the lower price to induce a higher output, the intersection of the lower marginal cost curve with the lower price line must occur to the right of the intersection of the previous cost curve with the higher price. I see no a priori reason why this need be the case. The relationship between the change in price and the change in marginal cost would appear to depend upon a number of things: (1) the magnitude of the negative slope of the labor supply curve, (2) the properties of the production function, (3) the shapes of the constant-product curves between each pair of factors and (4) the amounts of home-owned and purchased resources being used before the decline in product price.

On a multiple-enterprise farm, there is a possibility of substituting products as well as factors. Given the existence of a labor supply curve that is backward sloping and the possibility of and incentive for substituting home-owned resources for purchased resources, it may well be worth while to change the product mix even though relative product prices remain constant. If resource complementarity limits the possibilities for resource substitution in those enterprises in which the farmer is already engaged, he may reach the economic limit of resource substitution before he reaches the limit of his willingness to substitute home-owned resources for purchased resources.

The farmer will allocate firm-owned resources among products in such a way that the marginal revenue derived from the last unit added to one enterprise will equal the marginal revenue derived from the addition of the last unit to any other enterprise. The products that would be

in a preferred position to absorb large quantities of the home-owned inputs would be the ones that are relatively intensive users of home-owned inputs and whose previous volumes of production have been relatively small.

Dairying and poultrying would appear to meet these qualifications. They are relatively intensive users of operator-owned resources—labor, building space and feed—and are sideline enterprises on many farms. If this be true and the preceding analysis is valid we might expect dairy and poultry production to expand or contract in response to falling or rising farm income, respectively, independently of relative product prices.

Nonfarm Opportunities and the Slope of the Supply Function

Even if one accepts the validity of the previous arguments, he need not accept the hypothesis of an aggregate supply curve (for a particular product or for total agricultural output) that is backward sloping through at least part of its length. The previous argument has ignored the possibility of alternative employment opportunities. An operator's family might be willing to put in more hours with lower product prices if there are no alternatives. If, however, alternative employment opportunities exist, the point may be reached where their supply of labor to agriculture becomes zero as they change occupations.

Whether the operator and his family continue in farming or not will depend upon whether the equilibrium level of work and income in farm employment gives a higher or lower level of satisfaction than the equilibrium position in nonfarm employment. This in turn depends upon the nonfarm and operator wage rates and upon the rate of substitution between farm and nonfarm income. The argument can be formalized by use of a graph such as Figure 6. Here Y_f represents farm income; Y_{nf}, nonfarm income; OT, a technical possibility curve, i.e., a locus of points such that equal work time (measured by the length of the ray OT to the point) will give the amount of Y_f or the amount of Y_{nf} corresponding to each point on OT. (OT need not be a straight line.)

The graph is constructed from two work-income preference systems similar to Figure 2—one representing a farm employment system, the other representing a nonfarm employment system. With any given technological situation, farm work-income preference system and structure of product and factor prices, there is a unique relationship between hours of work, income and wage rate. The amount of work that maximizes satisfaction at this wage rate is plotted as point D. The farm income for this amount of work is plotted as OE. Suppose D of nonfarm work and OG of nonfarm income give the same level of satisfaction as D of farm work and OE farm income; that is, it is a matter of indifference

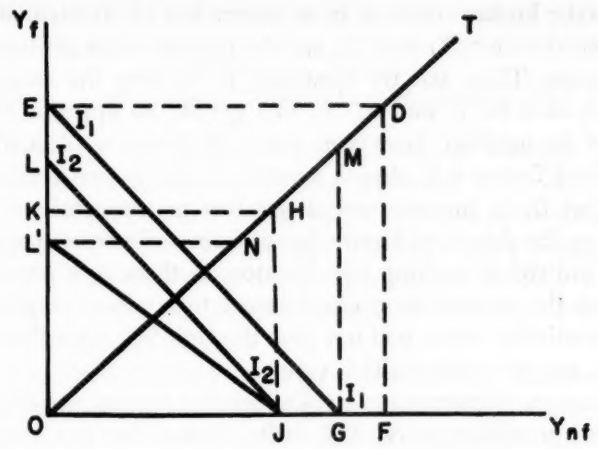

FIG. 6

to the family whether they have one combination or the other. The straight line I_1I_1 connects equi-satisfaction points OE and OG.

Suppose the nonfarm wage rate is such that equilibrium in nonfarm employment is H nonfarm work and OJ nonfarm income. Let OL represent the amount of farm income which must be earned from H farm work in order to attain the same level of satisfaction as is obtained from H nonfarm work and OJ nonfarm income. I_2I_2 connects equi-satisfaction points OL and OJ.

Nonfarm income in the amount OG can be earned from M nonfarm work and it is clear that this combination is preferred to D nonfarm work and OG nonfarm income since a given combination of work and income will be preferred to the same income and more work. Similarly, H nonfarm work and OJ nonfarm income is preferred to M nonfarm work and OG nonfarm income. This follows from the fact that the former is an equilibrium situation with the given nonfarm wage rate. From these arguments it follows that the combination consisting of H nonfarm work and OJ nonfarm income is preferred to the combination consisting of D farm work and OE farm income. Hence this family will accept nonfarm employment.

On the other hand, if OL were less than OK, say OL′, D farm work and OE farm income would be preferred to N farm work and OL′ farm income. This combination, in turn, would be preferred to H nonfarm work and OJ nonfarm income. In this case, the family would remain in farm employment.

How are Y_f and Y_{nf} measured? I would say that Y_f includes profits, entrepreneurial wages and labor wages. Likewise Y_{nf} includes all returns

accruing to the human resource in whatever line of nonfarm employment is under consideration. Y_f and Y_{nf} are the present value of these expected future incomes. Thus, strictly speaking, in making the transition from Figure such as 2 to Y_f and Y_{nf} in this graph, an appropriate discount factor must be applied. However, this will cause no difficulty since a given discount factor will always result in a one-to-one correspondence.

Notice that these incomes are dependent on expectations about the future and on the degree of knowledge of farm and nonfarm opportunities facing the individual making the decision. If there is a positive cost in moving from the present farm employment to nonfarm employment, the technical possibility curve will not pass through the origin but will intercept the Y_f axis at some positive value.

As farm income opportunities decline relative to nonfarm opportunities, the technical possibility curve OT shifts. Unless the II curves are horizontal, the point will ultimately be reached where the equilibrium position in nonfarm employment will be preferred to the equilibrium position in farm employment. Now we can see what a backward-sloping supply curve for agricultural labor implies. It implies horizontal II curves or a situation as represented in Figure 6 by OL′. In the latter case it also implies a limited decline in the farm income opportunities relative to nonfarm income opportunities. It is not sufficient that some families are faced with such conditions. Rather, in the aggregate the backward-sloping supply curves of these families must be less than offset by the forward-sloping curves of other families.

Summary

1. A complete explanation of agricultural supply requires present real income and highest past real income if the work-income preference system shifts with new peak levels of real income and the entrepreneur maximizes some combination of leisure and income.

2. A negatively sloped agricultural supply curve cannot be deduced from a set of general propositions. It requires a specific set of assumptions about these empirical phenomena: (a) the properties of the farm and nonfarm work-income preference systems of operators and their families, (b) farm vs. nonfarm income opportunities, (c) the properties of the agricultural production functions and their constant-product curves, and (d) the amounts of home-owned and purchased resources being used before a decline in product prices.

AGRICULTURAL ECONOMISTS AND FARM POLICY

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MUCH unexpected pleasure was gained by reading the *Journal of Farm Economics* after I had neglected it for nearly a decade and a half, while in the army and at various foreign posts after the recent war. The founding fathers had, it appeared, built well. Perhaps, a future meeting of the Association should now celebrate formally such men as Taylor, Black, Warren, Carver, Gray, Boss, Hibbard and a dozen others to whom the field owes so much.

The reading brought many and varied impressions. There was tangible evidence of increased power and scope in the writings and a distinct advance in maturity in the *Journal* articles as compared with those in the *Journal* of the senior American Economic Association. Also there had, as far as could be discerned, been no abandoning of the task of being agricultural economists and little evidence of any feeling that the time had come to abandon a branch specialty and move back into the main stream of general economics despite the great decline in the relative importance of farming in the nation's economy. Time had justified foresight and there was work for the economist dealing mainly with problems of agriculture.

One further characteristic of the copies of the *Journal* that had arrived here in Baghdad was the predominance of the articles written by the "measurers," and this fact recalled sour comments, encountered on brief visits home over the past decade that the science had lost a good deal of perspective and was now engaged too much in measuring fly specks and other phenomena of similar importance. A further look, however, revealed a fine perspective article by Prof. T. W. Schultz in the August 1956 number, reporting brilliant research by Fabricant. The science had gained from its work of measuring, since the advance in perspective, as outlined by Schultz, came in part at least as a result of earlier work of measurement.

The book review section of the August issue brought further evidence of balance in the field in the powerful review of Benedict's book on Agricultural Policy by Prof. J. K. Galbraith.[1] Perspective and dissent, necessary elements in any dynamic science, were therefore, still to be had from masters of the science who were, apparently, completely unawed by the measurers.

Just what portion of the science should be preempted by measurement

[1] J. K. Galbraith, Review of Murray A. Benedict, "Can We Solve the Farm Problem," *Journal of Farm Economics*, Vol XXXVIII, No. 3, August 1956, pp. 878-82.

and perspective, with its close relative, dissent, and what part should be devoted to looking ahead and policy making are problematical. Probably, on the roughest of guesses, measurement should have 75 per cent of the field, clarification and perspective 15 per cent with dissent and policy making dividing the remaining 10 per cent. Perspective, dissent and policy making are the spices of the science and using them in exactly the right proportion gives the proper flavor to the cake, with too much just as distressing as not quite enough.

The measurers have great right to count themselves the backbone of the science and are undoubtedly a great comfort to deans, bureau chiefs and other administrators who find them comfortable to live with. They provide, when they write intelligibly, an intimate and fine contact with operating farmers. The farm management arm of the science is almost wholly a measurement affair. Keeping their agricultural economists as useful as possible to farmers is a primary concern of the deans, who for this reason also favor the measurers.

On the other hand the policy makers, who are usually the bolder forerunners of the flock, are commonly the public front of the colleges and bureaus. They may not be so comfortable for administrators to live with though a really good statement on public aspects of farm policy attracts attention to a college and lets the public know that there is life in the ivory towers.

Prof. Galbraith, in his scolding of the agricultural economists for retreating to the role of scolds as far as policy making during the recent troubled times is concerned, has a point, however. If the administrators are not much of a deterrent to more vigorous policy pronouncements from the economists, something else must be. This article is an attempt to probe a bit into what might be the cause of any real or apparent shirking on the part of the agricultural economists in a field in which they have great (but by no means sole) responsibility.

The thesis of this article is that the causes lie partly in the background of economic training and partly in poor general perspective, on the part of the agricultural economists, with respect to economic forces.

Economic Principles and Forces

The gigantic effect that John Stuart Mill was to have on economics came not at all through the originality of his ideas or writing. In fact he is generally recognized by economic historians as having had little of originality. The effect came rather because he organized, with clarity, preceding economic thought and presented it to the academic public in the form of principles. These principles gained wide acceptance, particularly among English speaking peoples, and color deeply, to this day, the teaching of introductory courses in economics.

Mill endowed his principles, however, with a power that they did not quite sustain. To him, these principles represented overwhelmingly powerful economic forces. They are probably still so regarded by a majority of Western economists. Mill's writings came pretty much at the beginning of a new economic era. The new world had opened up. Ideals of economic freedom were gaining a hold on men's minds. Belief in the effectiveness and worth of statutory and other forms of economic regulation was weakening. Trade was breaking out of old confines as nationalism replaced feudalism in England and Europe.

Despite the fact that he overrated them, Mill's principles did represent economic forces and his writings had much to recommend them as a description of processes of generating and distributing income in a free or competitive society. Also Mill's statement of these principles of economics came a a time when conditions could hardly have been more favorable for their acceptance. Together with the powerful background literature, of which they were a summation, these principles came to represent the economic creed of the Western world. Background literature and the principles were accorded the name of classical economics: so great was their prestige. As a result, just as Marxism presents an implacable bar to the objective consideration of other economic systems in Soviet Russia so classicism slowed up the headway of other economic postulates in the West.

Yet classicism was weak in many important respects. Its principles were not, in fact, completely dominating forces. It was weak also in its presentation of economic dynamics so that a whole new structure had to be built along side it to explain what went on in a dynamic (rather than a static) society. It was weak in its relating of economic forces to other aspects of the dynamics of human action. The efforts of the institutional economists to make up for this obvious fault where, for a long time (and still are), met with great resistance. Few among the institutionalists were allowed any but somewhat tainted reputations.

A reinforcing of classicism had to be effected. As far as economic dynamics is concerned, classicism was pretty much finished off by J. M. Keynes, his predecessors and followers in England. The seeds were to an extent sown by the classicists themselves. It is easy to recall how the brilliant if tedious work of Marshall, in his "Value and Distribution," came to life when he departed from his text and talked with utmost clarity about the incidence of taxation in dynamic terms. Keynes finally gave economic dynamics an impregnable position in his *General Theory of Employment, Interest and Money*. That chapter is, therefore, finished and accepted.

The institutionalists have not been so successful. It is to a better understanding of their position and their contributions that the next great effort

in economics must apparently be made. The efforts of the institutionalists are in part to be understood as an attempt to bring economics closer to reality. A man using the tools provided by the principles alone was too often a parrot repeating the words land, labor and capital and, in argument, always placing his reliance on the "law" of supply and demand. But the institutionalists so often erred on the side of pointless description, tediousness and prolixity, that the teacher of economics was moved to say a prayer in praise of the teachable principles and to think how fortunate that the central theme of economics lay with the classicists rather than with the institutionalists. The real and the concrete are, in their totality, monstrously tough nuts to crack. Abstractions are a most attractive tool of analysis if, also, subject to great abuse.

The institutionalists had their points, however, and at best their descriptions were gems that the classicists with their abstractions, half truths, and constant apartness from reality, often failed to achieve. Furthermore, institutionalists made analysis of economic forces one of the central aspects of their presentations,[2] a thing that the classicists did not do so directly. Economic forces do not operate in a vacuum and, hence, are different in every situation that the passage of time brings along. The institutionalists were, therefore, pretty much denied the privilege of manufacturing undying abstractions and principles. Their writings became dated sooner than those of the classicists and few courses in economics based on their writings were established or are even now, taught.

Yet economic forces are of greater importance at any one moment than economic principles (so called) and teaching economics with disregard or failure to emphasize economic forces often leaves the student less than half prepared to begin a life of professional usefulness. Policy matters, farm policy included, are concerned with the responses individuals, groups or nations make, or are urged to make, to existing and anticipated economic forces. These are forces of the moment (not forces in the abstract) and part of the problem is to design a policy that will serve well

[2] To cite only a few examples: Veblen, for instance, particularly in his two books *Theory of the Leisure Class* and *Theory of Business Enterprise* dealt with the forces of acquisition and rivalry in display. Marx in his *Das Kapital* wrote, with tremendous spleen, in support of egalitarianism. Generally, the socialists wrote in support of one form or another of egalitarianism a force that Western economists may have persistently underrated. Henry George in his *Progress and Poverty* and Howard Bellamy in his *Looking Backward* were striking out against the private appropriation of "socially created" values which, in all truth, got badly on the loose in the rapidly urbanizing U. S. economy of the 19th century.

In a somewhat different frame of reference is another great essay by Veblen on *The Place of Science in Modern Civilization*. To many, labelling matter-of-factness as an economic force may appear to strain the concept of "force" more than a little. However, modern economics probably became possible only because of the growing ascendancy of the matter-of-fact approach over those based chiefly on superstition or creed.

in the dynamic world regardless of the inevitable changes in prospect.

If Prof. Galbraith, therefore, wishes to have agricultural economists participate more freely in debates on farm policy he must first see that their basic training is less wholly in principles and more in economic dynamics and in the identifying and evaluation of economic forces. With his two books on *American Capitalism* and *Economics and the Art of Controversy*, Prof. Galbraith has, indeed, already done much in this respect. For the basic teaching of economics, however, still further adjustment is clearly needed.

The ablest of modern economists have, of course, shaken themselves more or less free from their "principles" background. They have transcended it and as they deal with and write more about economic forces (much if not most of the writings of the working economist concern economic forces) their dependence on principles becomes less. But, that there are numerous economists who never outgrow, who quite clearly fear to outgrow their "principles" background, is, in reality, the theme of Prof. Galbraith's review of Benedict's book. A thumbnail summary of his review is that Benedict had been unable, apparently despite a determined effort, to unshackle himself from the "principles" approach to economics that had, one may presume, constituted his basic training. Benedict's presumed attachment to economic conservatism may have been a reflection of his attachment to principles and his fear of offending other economists with similar attachments.

This adherence to principles goes deep. Its great surface manifestation is the persistent reference to that rock of Gibraltar of conservatism in economics i.e., the "law" of supply and demand. But deeper down there is the acceptance of the price system as the basic distributor of incomes and the corollary dependence on competition in connection with the price system to hand out market justice, the belief in the desirability of the dominance of private ownership (capitalistic farming), the acceptance of dynamism as the normal accompaniment of economic development and the dislike of and contempt for paternalism in government.

Yet one need not go out of the U.S. to find the price system challenged. It may be a bit shocking at first to the sheltered economist, to find that a British rationing decree may, temporarily, constitute a more powerful economic force than the "law" of supply and demand. The challenge, the world over, to the workings of competition as the prime dispenser of market justice is certainly as great as its acceptance for the performance of that role. Collective ownership of property, in its more modern as well as its feudalistic forms, particularly as applicable to farm land, is as common and perhaps more common than private ownership as this is exemplified in the U.S. and the more anglified parts of the

United Kingdom. Most of the world fears the dynamism that the U.S. has come to accept. And paternalism is everywhere, even in the U.S., with its advancing system of social security, becoming the normal and preferred governmental attitude. Actually the economic systems of the world are now often prodigal mixtures of fixed and free prices, competition and regulation, feudalism, collectivism and private ownership, paternalism and laissez faire, dynamism and defenses against change. The world got that way from the exceedingly diverse responses to economic forces that people over its continental expanses have made and the institutions that they have established in their responses to these economic (and other equally powerful) forces.

The "principles" of economics have undoubtedly had a very powerful influence on the institutions of Britain and the U.S. Just as these "principles" have been in part a take off from the frontier, the frontier reinforced the acceptance of the principles. The frontier is, however, long since gone and the fact is that, despite the relatively firm acceptance of the "principles" in the U.S., its economy is no longer getting less and less like other economic systems in the world but more and more like them. That is, they are all, save the strictly communist systems, profuse mixtures of the free and the controlled as noted above. The U.S. system is merely a quite equally profuse hodgepodge weighted rather heavily still on the "free" side—as a remnant of its frontier heritage—but moving steadily in the direction of more paternalism, more dependence upon statutory and regulatory justice, as contrasted to competitive justice, in the market, and so on. That economic change should be in this direction despite the tremendous past achievements of the U.S. economy—undoubtedly the greatest achievements in all history—is startling evidence of the strength of countervailing, and still unwillingly recognized, economic forces.

The future may easily reveal that the world's economic systems are presently moving, from different directions, toward a single point. That point, in all probability, focuses on a mixture of freedom and regulation somewhat like the British have achieved (in Great Britain) or of the similar systems of the Skandinavian countries. Fewer countries than in the past appear now to be looking at the U.S. model as attainable; and the opposing extreme or rigid regulation probably reached its apogee with Stalin and Mao. That is, the Tito, East German, Polish and Hungarian revulsions almost certainly point toward a necessity to soften the socialist-communist regulatory front.

Granting this to be the case, the effectiveness of U.S. economists in world leadership—a leadership becoming more critically important to the U.S. everyday—is, as never before, in question. They apparently are in need of a far more realistic approach to the world's economic problems

than they have had in the past and that Galbraith apparently found in Benedict's book. Economists and other specialists working with the International Cooperation Administration in underdeveloped countries have often found the feudalism and paternalism of these areas much more stubbornly immovable than at first anticipated. Great as is the respect of these U.S. economists for private ownership of farm land and the honor they accord to the fabulously productive U.S. farming, they nevertheless, often find it impossible to move illiterate peasants, farming their land under a feudalistic share-cropping system, very rapidly up the tenure ladder.

On the other hand, they are finding some of the countries in which they work gripped by a fever of developmentalism. This economic force if properly understood, can be used so as to lead these economies away from excessive paternalism and regulation and toward greater economic freedom. Peasants under feudalism with their meager incomes fear change. Governmental officials of underdeveloped countries have to be taught the how and why of the fact that the U.S. has found it possible to couple change or dynamism with a high and rising standards of living: has indeed found it necessary to live with dynamism if the nation's living standard is to be kept rising. The evaluations put on economic forces by individuals, groups and the nations themselves in these underdeveloped areas are widely different from those in the U.S. The economist with only a "principles" background finds himself poorly equipped to work in such areas.

What is needed is an adeptness in evaluating economic forces as these are operating in the framework of the host country's institutions. This adeptness cannot be learned well out of principles text books. It requires courses in which principles, dynamics and forces are all given due consideration. The great dynamic force operating in these underdeveloped countries is developmentalism. If miracles of reform are to be accomplished in the transforming of feudal farming into owner-operatorship middle-class farming it will have to be done by those capable of riding the whirlwind of development to achieve their ends. Only major forces can be expected to be powerful enough to loosen the hard grip that an age-old feudalism now has on these economies. Development is a powerful force, and, coupled with the well-known acquisitiveness of peasants toward the land, there is a basis for optimism as far as the ultimate results are concerned.

Economic Forces and Farm Policy

Economic forces are the mainsprings of economic change. They are the drives that activate individuals, groups and nations (perhaps, latterly,

even the world's entire population), to put forth efforts to obtain the things they want to consume or use in building for the future. These drives are (from the economic side) constantly shaping and reshaping social institutions.

In an earlier period it was the drive to obtain more plentiful food that led men to settle down and till the earth. As a result settled farmers have now all but completely replaced hunters and nomads. The social transformation wrought by this drive is now so old as to be quite unremarked though undeniably great in its time.

The drive for food security has been replaced in modern times by the broader drive for economic security. The change wrought in the U.S. economy by this latter drive, which was stepped up so sharply after the 1930-1933 depression, is all but incalculable. The whole social security system with its provision for old age and survivors' insurance, unemployment benefits and the like has resulted from this drive. The fabric of fringe benefits now so prominent in the U.S. traces to this same source, as do a multitude of other insurance schemes including those covering sickness and accidents. The drive for parity prices and incomes for farmers falls in this same general category. The complexity of the results are familiar to readers of this *Journal*.

Not all drives are of such magnitude. Many relate to lesser objectives. Just now the drive for better housing is a major (though currently declining) feature of the U.S. economy. The drive for improved roads has led to the planning of a fifty billion dollar road construction program. Lesser but hardly minor are the drives that developed after the perfection of the automobile, radio and television. Thus the economy is responding at all times to a multiplicity of these forces. Gauging their intensity is indeed a major preoccupation of the working economist. Not all drives exert an expansive influence. Depression develops when drives for investment security and liquidity grip the country as they did to an unprecedented degree during the early 1930's.

Some drives are more latent than overt. Thus the drive to control population, already begun in Japan and India, has not yet reached the U.S. but may, when and if it arrives, bring in its train serious tribulation. Mostly latent till after World War II, the modern drive of the U.S. to defend and perpetuate Western institutions against the onslaught of Communism, first gave rise to the Marshall plan and, from thence, has gone on to a great broadening of international programs for technical assistance and for the spread of information about the U.S. and its culture. There are similar drives developing out of the discovery of the uses of fissionable materials for both war and peace. The adjustments that are

apparently in prospect for the world are presently one of its major preoccupations.

More generally, the greatest of the economic forces may well be war but, in the next rank (and probably, over the long run, in the first rank), stands the drive to develop. Most of what has been stated immediately above relates in one way or another to these two major drives.

People are profoundly moved by the desire to develop themselves and their environment. The force is so powerful that whole continents—the Americas—have been subdued in a matter of centuries. Right now the Soviet colossus is in the throes of the grip of developmentalism that has most disagreeably cheapened the lives of the human beings that it uses to achieve its developmentalistic ends. The force has by no means worn itself out in the U.S. and may even there be intensifying. It is unequivocally intensifying in the underdeveloped areas chiefly under the stimulus and guidance of the West and, in very considerable part also, as a matter of aping the undeniable developmental achievements of the communist regimes of the past 40 years, in Russia and more recently in China.

In the West developmentalism has been chiefly benign, though admittedly harsh at times on the Indians of the Americas and the blacks of Africa. Developmentalism under capitalism has, in other words, been on the whole, relatively humane and coupled with high regard for the individuals and groups that the developing nations have used to attain their ends.

Under socialism, and particularly under communism, the developmental drives have often been hardened and never has the process of development been prosecuted so ruthlessly and with such complete disregard for human life as in fascist Germany and communist Russia unless, indeed, it is being carried on still more ruthlessly in Red China. Revulsions against the extremes of developmentalism have been a constant feature of Western society. The recent revulsions against the developmentalism of socialism and communism, at the hands of Western peoples in Yugoslavia, East Germany, Poland and Hungary have been very bitter.

These major economic forces of war and developmentalism often make hash of the weaker economic forces of the traditional "principles." The "law" of supply and demand does not ride over the naked power of governments. The exact opposite is true. Hitler appropriated the German economy, adopted developmentalism and war as his central policies and for a time nearly doubled the productivity of the country. Stalin and Mao, with even greater ruthlessness, but without the same bias toward war, made the same use of the drive for development. The U.S., probably more than any other nation, gave developmentalism to the world; but

it is the fascists, socialists and particularly the communists that may in the end use this force to a most disagreeable extreme.

Farm Policy

Economic forces focus at particular points on farm policy. The major present drives of the U.S. are centered on its competition with communist countries in these key matters of war and developmentalism. The country is at somewhat of a disadvantage in both these rivalries because of a third major aim that it must prosecute but that does not activate communist authorities at all to the same degree. This is the drive for higher living standards.

A major question posed for agricultural economists is, therefore, "How does U.S. farm policy accord with these major ends of the nation?" With the handicap of its relatively small population and the necessity to use a major portion of its resources to maintain and lift living standards, the U.S. has no easy task confronting it in this rivalry of civilizations. It needs allies and needs them badly and the immediate question is, "How is farm policy doing in the matter of getting and keeping allies?"

There are two answers to this question. The first is: "In part, exceedingly well." The productivity of U.S. farming is one of the seven wonders of the world. Tying to the U.S. as a means of food insurance in case of war, and for assistance during post war reconstruction periods, is one of the major elements of attraction of other nations to us. The communists must, by contrast, ration food even during peace periods! Also the U.S. policies for agricultural education and research have enabled the country to provide some of the world's best agricultural technicians to the underdeveloped countries so that their drives for development may be facilitated. Our skill in scientific farming is most highly respected, our help greatly wanted and that, too, gains allies.

Our present aggressive trade policies are not so well oriented for the same purpose. The use of our farm surpluses to build food reserves in India and elsewhere gains friends. But an aggressive sales policy with respect to cotton could easily ruin Egypt and is a major nightmare to that country, which is at the same time the most inviting avenue for communist penetration into Africa and the important Arab world. Egypt has few alternative occupations to turn to: its industrial prospects being particularly poor. Already its 20 million people are dangerously crowded on its narrow strip of productive Nile Valley land. If it loses its market for cotton it becomes indeed a prime target for communism and its agricultural economy, scarcely out of feudalism, is more oriented toward collective farming than toward owner-operatorship of its farm land.

Under the circumstances: should the U.S. accept, or lead the way to a

role for itself of residual supplier of cotton (and farm products generally) in the world market? It can adjust fairly easily to reduction of its cotton market. Egypt cannot. There are dozens of other examples of how an aggressive trade in farm products weakens the U.S. with its present and potential allies. The dilemma thereby put on the country cries for a solution.

Bigger purposes resolve conflicts with respect to lesser purposes and the U.S. must apparently consider seriously what to do to lead the way toward still more constructive policies on trade in farm products. Intensifying competition (a "principles" answer) is hardly to be considered. The international repercussions would be too great. It will probably prove best to act on the suggestion that there be set up in the U.N. (or FAO) an "Advisory Committee on Trade in Farm Products" so that in that committee the U.S. can discuss with its allies proposals, as constructive as possible, on how markets for farm commodities should be shared among free nations. Indeed such a step is probably inevitable considering the U.S. concern for allies. But sharing markets particularly between independent nations is a complex matter and only to be undertaken if it provides some promise of being useful in the drive to contain communism.

A further illustration of a "forces" inspired resolution of a farm problem can be made in application to the domestic scene in the U.S. The country has struggled now for nearly 40 years (with an interruption only during the period of World War II) with surplus production of farm products. Yet it is probably no nearer a solution in 1957 than when it began its fumbling.

There is, of course, a drastic solution that can be used and used effectively any time the country really wishes to do so. A sufficiently stiff excise tax on fertilizers would cut total production quickly. The potential depth of the cut may be gauged from the USDA estimate that fully one fourth of farm production comes now from fertilizer use. The required institutional adjustments following such a procedure would probably be less rather than more severe than those attendant on acreage allotments, storage programs, school lunch plans and so on. The demand for farm products in total is, furthermore, highly inelastic so that both farm prices and farm incomes could be expected to rise more than proportionally to the cut in production.

Yet the idea of such a tax is offensive. It runs counter to both the nation's and the farmers' developmental urges. Ask the farmers to increase production and the morale of their (war time) response is magnificent. Ask them to cut and they drag their feet (chiefly by increasing their use of fertilizer every time additional acreage controls are imposed). Worse still, the rest of the country despises even more proposals to reduce farm out-

put. These run counter to the country's age old drive to develop: "Up Not Down!"

Latterly, failure of effective formulation of policy has become the more serious to farmers because of the decline (both relative and absolute) of the farm population and the consequent decline of farmers' political influence. More and more the nonfarm sector (now 88 per cent of the total population) is demanding that farmers be "put through the economic wringer." That is exactly what the "principles" inspired economists could most easily approve or at least condone. Such a stand, indeed, reinforces the "principles" economists in his belief in the "law" of supply and demand. "You can't lick it. So let's get this battle to save the farmers over with and let them sweat it out. The costs of the foreclosures involved will be small in comparison to the costs of the present relief program." The barometer of the problem, they go on to insist, is the rise of CCC surpluses. These are now $8 billion and may soon be $10 billion. Congress recently set a temporary ceiling of $14.5 billion.

A "forces" approach to the problem would, by contrast, seek to harness countervailing developmental drives to eliminate surpluses. There is not too much land in the U. S. Far from it. There is merely too much in use for farming (there may be too many farmers too) and the "forces" approach would be to propose programs to make the institutional adjustments that are clearly now necessary to get land moved out of farming into other uses. There are plenty of such other uses. They include uses for recreation, wild-life preserves, timber production, watershed protection and other conservational uses. In a country with the world's most up-to-date road system (and a $50-billion improvement to that system coming up), with most families owning an automobile and with many families having guns, fishing tackle, canoes, boats, cameras, binoculars and camping equipment in teeming abundance, the elasticity of demand for land to be used for recreation and conservation is certain to be very great. The "forces" answer to the surplus problem would be to adjust the laws and the institutions of the country so that these uses press in ever so much harder to restrict the use of land for farming as, indeed, they are already doing in Europe.

Such lands would apparently need to be moved into public ownership—to which there would be some objection. But that objection would be chiefly to federal ownership. If the land were to be purchased by states, counties and municipalities the opposition would probably be small. Money would need to be provided. That could be done by having the federal government allot part of the present appropriation for farm relief for purpose of matching state, county and local money put up for the purchase of land to be used for the creation of these recreation/conserva-

tion reserves. The lands to be put into such reserves would be mostly marginal crop and pasture lands so that a large acreage would have to be purchased before there would be much effect on production. That is surely, however, only an advantage since there are probably few things the country craves more, and is willing to pay more for, than outdoor recreational facilities. Time would be required, but probably much less time than for the temporizing programs now used in the attempt to cope with the problem. The cost will be great but probably less, results considered, than the money now being frittered away in programs that are proving largely futile.

The institutional adjustments required would be no more difficult to make than those already called for under existing programs. There is the advantage that the now dominant urban population would have a stake in driving forward such a program since it would be getting something real and desirable for money that it now considers all too often as something that just goes down the drain.

The "forces" or institutional approach can do no more than supplement the "principles" approach; but that supplementation can be extremely important for the functioning of agricultural economists in the field of farm policy. If there is something in Galbraith's accusations, and there probably is, the fault must be in the training and background rather than in the ability of the agricultural economists which seem to have gained rather largely in recent decades. At any rate the need for consideration of more balanced training for agricultural economists can probably be rested on the evidence of four decades of unimpressive contributions in farm policy matters on their part.

DEAR LAUREN SOTH: MUST WE SO NEARLY DESPAIR?

JOHN D. BLACK
Harvard University

DEAR Lauren: You end your remarkably stirring book on *Farm Troubles** with the paragraph: "So we will continue to muddle along by compromise, experimentation, and half measures. This is the way of democracy, and it is the best way."

Or at least it looks this way to you in contrast with what you saw on your recent tour of Russian agriculture.

You strongly insist that the Number One problem facing our agriculture is that of improving the lot of our low-income farmers, and in your excellent chapter on "The Neglected One Third" outline a very specific set of measures for dealing with this problem. I agree that it is the Number One problem and pretty much with your set of proposed measures. But in your final chapter the best you can say as to a solution is: "Now there are a few signs that positive action will be taken" (p. 217).

Your Number Two problem is "keeping farm income up" (Chapter 13). But in your final chapter all you can say is that as a result of 23 years of struggling with the surplus problem we now "know a good deal about it." But "the lessons have not been followed in practice," and "progress has been slight" (p. 217).

And so on with the series of problems you deal with in Chapters 6 to 15. The question I ask is this: Do we need to be so nearly helpless to make progress along these and other lines you designate as your concluding chapter implies? Aren't there some things we can get a majority of our democracy to support that will step up the rate of progress importantly—not greatly at the very start perhaps, but acceleratingly thereafter? You yourself in your chapter on "Farmers in an Industrial Economy" call attention to the success of the procedures and organization set up under "The Employment Act of 1946" in introducing an increasing measure of orderliness into the behavior of the general economy. As you point out, in terms of economic magnitudes, agriculture is now only a very small fraction of our nation, but because of our political organization it weighs heavily in national elections and in decisions in Congress and The White House. If we could only have a fairly peaceful and contented agriculture for a decade or two, the upper levels of our federal, state and local governments would have much more time to deal with matters of far more consequence to most of our society.

* Lauren Soth, *Farm Trouble*, Princeton: Princeton University Press, 1957. Pp. vii, 221. $3.75.

Problem One

Surely it will be logical to consider first from this point of view your Number One problem, the low-income one third. You outline in this chapter and in Chapter 9 on "Too Many Farmers" very definitely what needs to be done to help this group. Put in logical structure, your proposals are about as follows:

1. In counties with a goodly number of low-income farm families, divert a major part of the extension work from technical services to already skilled larger commercial farms to the low-income farms. Serve the former much more largely by more general media of communication—publications, mailed releases, radio and the like.

2. Use whole-farm planning as a principal educational procedure with low-income farm families. You say that new practices are seldom accepted by such families except as "part of a reorganization plan for the whole farm." This will require either expanding much the Farm and Home Development Program, or shifting it in a large way to the low-income parts of the counties for a while.

3. A much expanded program of credit to low-income families to enable them to enlarge their holdings, and livestock, equipment, and operating capital to go with more land. The whole-farm plans will need to provide for including this additional land and accompaniments.

4. Offering to young people in low-income farming areas a kind of vocational education that will prepare them for non-farm occupations.

Comment is needed on each of these proposals. You are entirely right, Lauren, that too much of the effort of the agricultural extension is devoted to those who now need it least. In wartime, when increase in output fast was almost the sole consideration, it was good strategy to work most with those who would respond with the largest increases in output. Today, the best strategy is instead to work most with the smaller low-income farmers and help them increase their incomes by farming more land. This will provide them with much more nearly full employment and increase commercial output only a little. Indeed, if the farm plans worked out with them provide as they should for a shift out of hand-labor crops like cotton and tobacco toward feed grains, hay, and pasture, and are adopted by many other farmers, they will reduce output significantly.

It is true also that the whole-farm planning program is proceeding rather slowly, even with the larger commercial farmers. One reason for this is that far from enough extension service personnel has been trained for it. Most extension workers were educated as specialists in agronomy, animal or dairy husbandry and the like, and have devoted their efforts since mostly to the technology of crop and husbandry practices. It is

not easy to change the thinking and habits of a man of 35 years or more unless you can change his environment. Another reason is that the data needed for analysis of a majority of alternative farm set-ups are not readily available, or at least take time to assemble and organize for use. But more important than any of these is the fact that there is a little leadership in the upper ranks of the agricultural parts of many of the Land-Grant institutions that really senses this program and the need for it. Given some funds for it, they are willing to add it to what they have been doing, but even then they tag it on in such a way that it hardly becomes distinguishable from it. A fourth reason is that the undertaking has not been well organized in some of the states. For example, an attempt may have been made in many cases to start the program in all or most of the counties at once and get the regular extension staff to do it. Conceivably this may have worked out well in a few states.

You are also right, of course, that the credit agencies now in most low-income counties fail to make all, or anywhere nearly all, the loans needed in such counties to enable the small-holder farm families to get the additional land they need and accompanying livestock, equipment and supplies. FHA underwriting of such loans by local banks offered promise for a while, but was too inflexible in the matter of interest rates. Of course the general public, so far as it knew anything about the FSA-FHA, thought of it as a depression relief agency, no longer needed with wartime and postwar prosperity. It has been associated very little with the low-income farm problem in the minds of the public; or for that matter, in the minds of the dominant thinkers in the present U. S. Department of Agriculture. To them apparently, as you state, it is a socialistic invasion of private banking. The tenant-purchase part of the FHA program is of course thought of generally as directed toward tenancy, even though in its post-war years the loans could be used by owners to buy additional land, and have more largely been so used in some of the years at least.

Your vocational education proposal of course calls for a drastic change from present thinking in the low-income rural states. You and I haven't forgotten how in the war years the Southern States blocked all they could the movement of surplus farm hands to northern industry. Proposals of the U.S. Employment Service to recruit factory workers in the South were rigorously vetoed in Congress. Only in a few urban-fringe areas are the 4-H Club projects other than strictly agricultural or rural home-making.

What are the chances of any change in any of the foregoing in the next decade or so? As you indicate, "fifty counties have been selected for intensive experimental programs in helping low-income farm families improve their status" (p. 217). Apparently you are not expecting much to

result from this. What needs to result is a decision to start at once in many of these counties some appreciable part of what you have outlined. You could have told them this before they started. I pretty much did, as a matter of fact, in my reply to the letter of inqury on this subject that Secretary Benson sent out to agricultural economists about two years ago. The first step will be the planning of the enlarged farms: Then will follow the arrangements for buying of the land and financing of this, and then the procurement and financing of the needed livestock, equipment, and the like. The first of these steps should at the start be mostly an extension service undertaking. If, however, any farm appears from the start to be one which will require an FHA loan, the FHA should participate in the planning. All plans should also be checked with the technician of the Soil Conservation District and the representative of the Agricultural Conservation Service. The extension service should as its next step, except in the case of the clearly FHA loan farms, establish contact with the local banks farm by farm to see if they are in position to make the loans on these farms; if not, then with the nearest Farm and/or Production Credit Association; and finally with the nearest FHA office. The extension service will need to do a good bit of the following up of the loans to see how the plans are being carried out and help with the execution of the plans, except in the case of the FHA loans.

The least that will be required in any one of these fifty counties in the experimental stage is the full time of one man and about half the time of one woman. This pair should be able to plan at least thirty farms in their first year after the reconnaisance year and more after that. Presently, it should begin experimenting with a small-group approach to part of the planning of any farm.

A major question to be decided at the federal level is whether to promote this program with low-income farms only as fast as it can be done by redirecting the work of the present extension staffs away from the higher-income farms to the low-income farms, as you essentially propose; or to buildup an additional staff to do this work with the low-income group, or to do some of both.

My judgment is that the third of these alternatives is really necessary if enough progress is to be made to meet the crucial needs of the present. Whether at the county, the district, or the state level, the present extenison staffs are so occupied with the things that they have taken on one after another that they find it difficult to spare time for as absorbing an undertaking as helping their low-income farm families reorganize their farming along more expanded lines. Moreover, there is the strong tendency which you point out for the successful farmers who have profited from extension service technical guidance in the past not only to keep on

asking for it, but to ask for more and more of it. You and I both know the story of the one hundred and fifty top-flight farmers in a midwest state who when organized into a club used all the time of one state extension specialist. It is the more productive farmers who have supported the extension services all these years. While it is not suggested that they be "neglected," it is proposed that they be given less individual attention. Even this will be hard for the extension agents to do. It surely will be hard for the extension directors at the top to accept it as policy and still harder for them really to carry out.

Still, there is at least a small group of state extension directors who will subscribe to the wisdom of giving more help to the low-income farm families along the lines you have indicated, and who will make a clear effort in this direction if given a chance, and the proportion of county extension workers answering this description is larger than of the directors, especially among the women. If these can be given help, they will show the way to the other extensioners and put them increasingly on the spot as public pressure builds up.

This public pressure is an important element in this undertaking. There will be some among the farm organization officers, especially at the lower ranks, who will oppose even publicly any special effort to help the poor farm families. They may even go far, as did a geography professor-farmer at a Massachusetts Farm Bureau meeting some years ago, as to say, in effect, "These poor farmers aren't worth a damn any way. Just let Darwin's law of survival of the fittest continue to operate." Or more likely, as you point out, they will say that these families are satisfied with what they now have or they would work harder and live better. Of course there is often much truth in the latter statement.

Also, of course a sizable fraction of them are too advanced in years for any such venturing. Still, among the low-income ranks is a considerable number who need only to be shown a way out of the hole they are in. (In the case of my family, moving to a new community with a free public high school only a mile and a half distant proved to be the way out.) There will be enough families like this in almost any community to get the program started, and other families will soon line up after the first few.

Not only is giving the farm families struggling for it a way out of their low-income holes still in the prevailing American tradition and mores, non-farm as well as farm, but also rousing others of them to a realization of its possibilities. The difficulty is that our non-farm people generally do not know about the plight of these low-income farm folks. They do not realize what you point out, that rural slums are proportionately much more prevalent in this country than urban slums. Most

of them never heard anything about them, and if they have they mix them up in their thinking with all of the hollering they hear about low farm prices and income, which they have come to discount as in good part political hokum. It is going to take a high order of leadership to wake our urban folks up to this situation—nothing less than the kind of leadership that comes from the White House. The Department of Agriculture can help only a little in this awakening process. The Secretary's office is too much involved in price support gymnastics and debate. The federal part of the extension service will have a large and noble task to perform at the implementation stage, but is severely circumscribed at the policy-making level. The American Farm Bureau could help greatly in this matter if it could only become truly American. The other two farm organizations could help too, but they would need to clarify their thinking on the subject and weed out some of the ideas that they have commonly messed it up with.

You will agree with me, I am sure, that your proposal to educate farm youth for nonfarm occupations will encounter large obstacles if projected head on, such as by setting up rural trade schools. What must be sought instead is a more gradual approach to it. Following are a few suggestions of this sort:

1. In the older-youth club work in territory surrounding cities, include some projects that are oriented in the direction of urban vocations that offer opportunities for urban employment and enterprise. These projects might, merely to illustrate, involve learning to use certain tools or equipment, or might acquaint them with certain products and their manufacture in these cities. Interviews could be arranged with staff members of firms and plants could be visited. To be sure, these young people would get little or no actual training from such projects, but they would get a good deal of conditioning for off-farm occupations later, which is the major consideration.

2. Some of the more progressive firms in these cities might presently offer winter training courses for small groups of farm boys ready or about ready for jobs.

3. The regular 4-H club work can in some areas be broadened to include some preparation for urban as well as rural living, and gradually a few projects that prepare for off-farm occupations.

Two important considerations that you name are involved here, one, that already a considerable fraction of the farm families have off-farm jobs, and the fraction is growing, and the other, that farm and urban living are becoming more and more alike.

Then there is the difficulty that the poorer families do not now get drawn into club work to the extent they need to be to realise the goals

of such a program. Simple diversion of effort much more to these families will meet this difficulty.

Clearly a program of this sort must be adapted much to fit different situations. Probably it should not be undertaken at all in most good farming areas of the Midwest now growing industrially. The farmers in many such areas are already faced with acute labor shortages, and the absorption of too small farms is probably going on fast enough already. At the other extreme, the remote mountain areas of the South are too far removed from the cities for such a program to be effective. The best prospects for success will be in those areas with many too-small farms within twenty-five miles of flourishing cities.

Not education as such, but very important is it how well the federal and allied state employment services are now functioning as recruiting agencies for urban labor in over-populated rural areas. I have been out of touch with this since the war. Certain Southern congressmen were opposing it bitterly then. They were not going to have any of their territory depopulated even to win a war. And didn't most of those who had left in the last war and the booming industrial 1920's have to flock back in order to live in the years of the Big Depression of the 1930's?

Problem Two

Let the foregoing suffice for your Problem Number One. As I said in my reply to the Benson inquiry a few years ago, it is pretty clear what needs to be done—the difficulty is in getting the agencies to do what they can as now set up and Congress to authorize what more is needed. Your Problem Number Two—surpluses and price supports—is much more involved. You conclude very definitely that the big over-all political answer to this problem now being implemented—parity or near-parity prices plus production control—is proving to be a bigger and bigger failure each year. I must agree with you. I call this a political answer because it is what has evolved out of the contest of political forces in this country since 1938. There are many who say that it is working with tobacco—why can't it be made to work with cotton, corn, wheat, etc? I shall consider the case of tobacco a little later.

But failure though the present price-support plus production control program may be, this does not mean that nothing can be done to help. You yourself single out several positive means. Let us review them.

But before we do this, we need to make certain of our terminology. First of all is the difference between price supports and income supports. Sometimes in your book you put them altogether under the names "guaranteed prices," "price supports" and the like (pp. 147, 148, 161). I shall here distinguish consistently between, first, measures that support

prices in the market place, including loans without recourse, purchases to hold a product off the market for the short run, and purchases for distribution outside the usual channels of trade at home or abroad; and second, measures that take the form of direct payments to producers to make up the difference between the market price and some level of prices, like 90 percent of parity. These latter are really income-support rather than price-support measures. Then there can be a combination of these two—some purchases in the market place and then making up in direct payments whatever difference between the market and support price that still remains.[1]

We also need to see clearly the relation between your Problems One and Two. You say very definitely in your Chapter 6 in "The Neglected One Third" that the government programs so far "are of little benefit to the poor people in agriculture" and single out price-support guarantees as the clearest case of this. You point out that the lowest-income one million produce very little and sell only a fourth of what they produce. Yet in your Chapter 9 on "Too Many Farmers" you espouse Professor T. W. Schultz's proposal for "Homesteads in Reverse," which would include a subsidy of $5,000 per family to help move out of agriculture families that had produced at least $2500 worth of farm products in the preceding year, and say that this would tend to cut farm production (p. 133).

The "Homesteads in Reverse" proposal has much to commend it, but, as you recognize, it has small chance of acceptance by Congress. It represents too much of a reversal of the American tradition. Its opponents hold up to our view the horror that has happened in recent decades to the repressed agriculture of Russia, Australia, and the Argentines. But making credit more freely available to those who can buy out other too-small farmers to the mutual advantage of both can help considerably to this end. It will provide the poorer families part at least of the funds they need to finance their moving to city employment. Or if they decide to become part-time or residential farmers still living on the old homestead, it will help finance some badly needed homestead improvements or the purchase of a much needed family car, or the like. It is obvious that such a program really imposes on the agency helping with the planning the duty of deciding which families to help off the land and which to help to prosper in farming. Whole-farm planning as now being done is already helping in this way, but can be made to help much more than now. About 50 of the 241 New England dairy farms in a whole-farm planning project in the years around 1950

[1] Called "supplementary payments" in Black and Kiefer, *Future Food and Agriculture Policy*, Chapter 21.

had within three years after the planning made shifts of the foregoing general character. In central Massachusetts, the 75 commercial farms in such a project first planned around 1938 were only 46 farms in 1954. Part of these changes would have come anyway because farm jobs were unusually available in most of these two periods, but a larger factor in them was that the planning analysis showed the limited possibilities of their farms. And this was an effect not in the minds of those setting up the projects at the time. It was their intent to choose for analysis only very few farms that did not promise a reasonable return after replanning. The evidence is clear from this experience that planning with a clear intent to get small farms absorbed into economic units, with credit to go along with it, can accomplish much of the purport of a "Homestead-in-Reverse" program.

We need to be fully aware, of course, that the farm planning assistance to low-income farm families can also work to increase the output per acre of their too small farms and thus augment the surpluses a little. This need not happen, but will unless guarded against very strongly. Thus the 47 small cotton, corn-hog and cattle farms planned in a small watershed in central Tennessee would yield net incomes of $3000 as against $1000 as then being farmed. Commonly it is simpler to increase income by stepping up crop yields, improving pastures, and feeding more livestock than it is to buy more land. Those who did this planning, however, were not at the time thinking of surpluses. Any whole-farm planning done from now on must do so increasingly, even on the low-income farms, although it is far less important here than on the larger commercial farms.

This is a good point at which to consider the tobacco parts of the AAA and later price-support programs. You are surely right that they have contributed much in the South to keeping up the numbers of too-small tobacco farmers by giving them an assured market at good prices even though the acreage allotments were small in the first place and have been reduced and probably will have to be reduced still further because of acre-yield increases. Because their allotments were small to begin with, the levels of living were low, but these families were used to them. And of course they have risen significantly since the 1930's. Put this fairly large group together with a considerable fraction of the cotton farmers who fit into pretty much the same description, and the result is a heavy weight bearing down on the average farm income of the nation; and we have to say that the price-support plus production-quota program is in some measure responsible for the persistence of this heavy weighing down of average incomes.

Consider the case of cotton first. The Census has a special classification

called "cotton farms" which includes all the commercial farms whose gross receipts are more than half from sales of cotton and cottonseed. For that group of states called "The South" in the Census, stretching from Delaware to Texas and Oklahoma, the land in cotton farms declined 5 percent from 1950 to 1954, and the cropland harvested declined 10 percent, but the number of cotton farms rose 13 percent. This was in spite of steadily increasing mechanization and consolidation of cropper units on rented farms. But the number of farms reporting the growing of any cotton did decrease a good deal in the Old South—for example, from 145,000 to 106,000. Apparently the effect of mechanization was to cause cotton growing to concentrate on fewer farms, this including the shifting of some farms to relatively more cotton by increasing yields and getting control of more acres.

The Census has no classification called "tobacco farms." All that one can do is report the number of farms growing tobacco, and the acreage harvested; and this had better be by states. Kentucky had a decrease of 2 percent in the number of farms growing tobacco, and Tennessee and North Carolina even less change. The tobacco acreage increased 11 percent in North Carolina from 1950 to 1954, but only 4 percent from 1945. Tobacco acreage in North Carolina had been gaining ever since 1920, a total of 45 percent. Cotton acreage, in contrast, had declined nearly a half.

This is far from an exhaustive analysis from this point of view of the recent changes in cotton and tobacco farming in the South, but it does seem to indicate a clear tendency of the number of cotton and tobacco farms to persist, especially so the latter. Both of these are hand-labor crops to a large extent, and especially so the latter. A recent bulletin from the USDA reports cotton as using 84 man hours of labor in the South Atlantic states, 45 of this pre-harvest.[2] The comparable figure for flue-cured tobacco is 516 hours, and for all tobacco in the South Atlantic States, 509 hours. Even at support prices of 90 percent of parity, most of these farms have relatively low incomes with their small quotas.

In the aggregate, of course, the number of farms is declining pretty rapidly in the South, especially of the very low-income ones. The number of "subsistence" farms ($250 or less of sales of farm products) has fallen two-thirds since 1920. It could well be that the readjustments called for are already proceeding as fast as is wise in view of all the other related factors. But if so, then the people of the South who are demanding higher support prices should stop and really think through this problem. Do they really want to perpetuate in the South a hand-labor type of agricul-

[2] *Labor Used for Field Crops*, by Reuben Hecht and Keith Vice, Statistical Bulletin No. 144, USDA.

ture that will not stand on its own feet? Shouldn't that kind of farming be left to the over-populated low-income parts of the world?

Surely the measures proposed for low-income farm families generally under Problem One should be pressed rigorously in the cotton and tobacco areas. This will step up the transition to higher incomes by promoting the consolidation of the acreage quotas on fewer farms.

But is there nothing else that can be done? Making the quotas transferrable without attachment to particular farms has been proposed, but this would introduce serious evils that would be difficult to control. Maybe it would be feasible, however, for the government to offer to buy the relatively small quotas, this providing funds that would assist poor families in transferring to urban employment and save some of the further reduction in acreage quotas with rising yields.

It should be evident by now that Problem Number Two is by no means independent of Problem Number One. They overlap and even conflict in the case of the smaller commercial farms who benefit enough from price supports and quotas, or are hypnotized enough by them, so that they tend to stay on their small farms more than they otherwise would.

Now let us take up the question of the level of the price or income supports. Your clearest pronouncement on this subject is in Chapter 10 on "Price Supports": "A price kept far out of line with demand and supply may give the farmers income protection for a while. But if it does not perform its other functions of guiding production and consumption properly, farmers will be the losers in the end." Then you say that "The unhappy results in the early fifties from price supports for some commodities that were far too high should not blind us to the useful function that price supports can serve in helping to stabilize prices."

All this strongly suggests a level of supports that averages out the same as market prices over a period such as a production cycle. But you say at the beginning of Chapter 13 that this will have only a minor effect on income, and yet you seem in general to approve of the goal pursued by government for two decades of equality of farm and nonfarm incomes. You cite the government statistics of $900 per-capita farm income *vs* $1800 non-farm as evidence of the disparity of income in Chapter 3, and refer to them again in Chapter 15. But in Chapter 5, you say:

> "On examination, however, this disparity is quite meaningless as a measure of disparity of income. . . . If only the 2 milion farmers who produce about 85 per cent of the farm products for market are considered, then per capita farm income would not show this great disparity."

In fact, at a later point, you show no disparity at all.

The foregoing is about as close as you come anywhere in your book

to indicating the level of price and income goals for a farm price program. Surely we must have something more definite than this if any success is to be achieved with any program in this line. It is all right for you to condemn the use of the parity formula. But one can scarcely expect the farm public to sit back and let whoever happens to be Secretary of Agriculture and his staff set the level of prices for loans and purchases product by product without any guiding principles.

I agree with you that stability of prices and income should be the major consideration. The instabilities that we have to deal with are of several origins all of which need to be taken into account—the weather; over- and under-planting or breeding, either in production cycles or as a result of wars and postwar recessions or new developments in technology; also the more or less abrupt price movements due to business cycles, to unusual competition in domestic or foreign markets, etc.

If stabilization of prices is the only objective, an "ever-normal granary" functioning as you outline it in Chapter 12 has a major contribution to make. As you say, there should be for each storable product an "agreed upon reserve" that is stockpiled in ordinary years as a "reasonable carryover" in the national interest as security against droughts, wars, etc., and the amounts carried need to be larger than the trade itself has usually been willing to carry. With the granary functioning in this way and with the objective named, the level of prices set should be as close as possible to that which will balance supply and demand over some period like the decade ahead. This means that when the granary is full, and stocks are piling up in the trade and on the farms, the purchase price should be lowered, and that sales prices should be raised under opposite conditions—in fact, raised enough so that the granary is never emptied. Otherwise, prices will be held above or below the market level. To be sure, an ever-normal granary program functioning in this way will not level out prices altogether, but it will still stabilize them a good deal. It will also serve much to stabilize incomes. Ordinarily the price of big crops falls so much more than the size of the crop is up that total sales receipts are much too low. The higher prices resulting from stockpiling in these years will partly have this effect; at least they will tend strongly in this direction, and contrariwise in short-crop years. It cannot be too strongly stressed that the agency conducting such a program must have an announced price and stockpile policy and stick to it rigorously.

But there are definite bounds to what such a granary program can accomplish. First of all, it cannot be applied to meats and other perishables; and can be applied only in a limited way to semi-perishables like butter and cheese. You, Lauren, are particularly concerned with leveling at the hog-corn and beef cycles. What you propose is forward pricing

at some level about midway between the bottoms and tops of the recent hog-corn cycles. I would like to see this tried, first with hogs, and then with beef cattle. I would attach two stipulations to such an undertaking, that the forward price announced be, say, 5 or 10 percent below the projected cycle average, and that the program be started about the middle of a cycle. We must not forget that an assured price brings a larger response than an uncertain one. I would also like to see forward pricing tried with butter and cheese.

And of course granary operations such as outlined can contribute relatively little to preventing the sharp farm price breaks that come with severe business recessions. With mild ones, and granaries not full, they can strengthen farm prices for a while, but in so doing will presently be operating above the market price level.

With forward pricing, and prices set for a whole production cycle, the government will be faced with the necessity of finding some way of supporting prices when the trade cycle break goes below the support level. But it has this problem anyway whenever the farmers breed too many sows or cows, which they are pretty sure to do at some point in the first cycles in the trial heat. Buying at the support price and distributing outside the usual channels of trade seems to be the only possible procedure. This will ordinarily not be enough.

This brings up the whole problem of supporting prices above the market levels. You have said very definitely that it can be achieved only in one or the other of two ways, or some combination of the two. The two ways are restrictions on production, or distribution of the surpluses outside the usual trade channels. And then you have said that no combination of these two is proving sufficiently effective now, or is in prospect of doing so, unless we are soon blessed with some bigger droughts than those of the last two years. What you say in this subject is of course fully in line with the Black-Bonnen conclusions in The National Planning Association Special Report No. 42, "A Balanced Agriculture in 1965."

Realizing full well that this is the situation, the Administration in Washington is resorting to desperate measures along both the production and the distribution lines—the soil bank, and disposal mostly abroad. The soil bank is not only desperate, but is a big costly gamble. We have yet to see the outcome of it. The impact on this country's international relations of the disposal program over the next ten years is equally problematical. But price supports based on parity, they had to have in 1956. There seemed no other way for the Republicans to win the election—or for the Democrats!

If the political situation has not changed, and as many members of Congress as in 1956 still think that their vote-getting constituents want

parity or near-parity prices for farm products, plus production control for the basic crops, in spite of their baleful effects, then I shall have to agree with you, Lauren, that so far as Problem Number Two is concerned, despair is the right word.

But are there not signs of change? Do not more of the two million farmers who produce 85 percent of our farm output now recognize that prices of farm products in 1946-48 and again in the Korean War period were war-made peak prices, and similarly for the farm and nonfarm price ratios, and that they have no reason to expect their continuance, and that farmers must adjust their operations to the reduced overseas demand. Of course large numbers of them have already made needed adjustments and are prospering as much as in 1946-48.

Also have not more urban folks become more roused to the unreasonableness of support prices that are followed by growing surpluses?

The vote of the Eastern congressmen on the corn bill is also significant.

If there has been some change in the ways mentioned, it may be politically feasible for the administrators of the agricultural program in the next two years to set loan and purchase prices of other than the basic six products and even a couple or so of the basics more nearly in line with market conditions, so that by 1960 the surplus will be of manageable proportions. Once the position is reached where the government is no longer in effect saying to the producers of a crop, as it did in wartime, "Go ahead and produce another big crop and we guarantee you the same good price we got for you this year," the surplus problem will have made much progress toward a solution.

At this point, we should consider more specifically what are some of the departures from regular market prices that may be warranted. One of these has already been indicated, namely, holding up buying or loan prices for a while at the onset of a business recession, or of a surge in output of some product. But this can easily be overdone—as in the case of cheese in 1952-54. Production of cheese was higher than in the same month of the year before for every month from Nov. 1952 to June 1954. But not until April 1954 was the support level dropped, by which time nearly 400 million pounds of cheese were in government hands. Yet the Agricultural Act of 1949 under which the operation was carried on specified that the support level should be that between 90 and 75 percent of parity which would "assure an adequate supply."

The other principal devices that can be used within limits to support prices above what would otherwise be market prices are of course distribution at home to groups that otherwise would use less of the product, or into uses that otherwise would be too costly (e.g., skim milk

powder in animal feeds), and distribution abroad that represents additional consumption. In effect, all such distribution creates additional demand and raises prices in the market place. Any one of these measures can properly be used, part of these more extensively than now, but the use of all needs to be analyzed carefully and to be more discriminating. Also a distinction must be made between their use to meet a general surplus situation or a business recession situation, and the like for some one line of production.

To illustrate one phase of the foregoing, we could properly take stronger measures than heretofore to distribute pork or eggs or cheese or skim-milk powder among the lower-income one-third of our domestic consumers whenever supplies of these get so out of bounds as they have in periods of a year or two since 1950. The Brannan proposal to let the price fall to a market-clearing level and make up the difference in supplementary payments to producers would have been very costly in proportion to the results because the upper-income two-thirds expands consumption very little as prices fall. This is entirely in line with your thinking, Lauren. What would seem most practical would be to have a standby organization and a standby list of families on relief, on unemployment security, and the like, plus other low-income families certified by the proper local authorities, that are supplied purchase certificates for foods in surplus, these certificates being adjusted to the size of their families and probably their income deficiencies. These purchase certificates would need to be considerably larger than the family's usual consumption or they would be used merely to replace present purchases. Even the use of such certificates to replace present consumption of our own poor people, however, will be better than diverting it to animal feed or most overseas disposals.

No feat of the imagination is required to realize the service that such a program could render in a general business depression or a spell of unemployment in some area. Present relief measures in such situations are far from adequate, and to use farm surplus relief as a supplementary measure is highly rational. Drought and flood relief fit under this same heading.

You will agree with me that if the Aiken food stamp plan had been advanced during a severe general business depression, it might well have been adopted, but that something like the foregoing, less inclusive and pointed more directly at surplus disposal, is all that stands any chance of acceptance now. Why don't you get some member of Congress to try drafting a bill along the foregoing lines and presenting it to the committees concerned?

Now as to disposal of farm surpluses abroad. I agree with the conclu-

sions of the recent study made by The National Planning Association only on one set of assumptions, namely, that we had to build up these stockpiles, and having done so, they simply had to be gotten rid of somehow otherwise than by letting them spoil. Otherwise I would have to rule out part of the disposals as unwise. It would have been better in the first place not to have set loan and purchase prices so high and thus not to have built up all these over-large stockpiles, and in the second place, to have distributed somewhat more of them at home. Granted the set of assumptions, however, I concede that the administration may have done as good a job as one could reasonably ask in the rush of an emergency; but we must do considerably better than this if we are going to continue to dispose of farm products in other countries outside the usual channels of trade, as I hope and expect we are. The most important revisions needed have to do with the displacing of exports from other countries and with ensuring that more of the products shipped are additional consumption. Also it is to be doubted if this country should continue in effect the producing of extra farm products merely as a way of providing foreign aid.

Now as to income parity as distinguished from price parity: the original designers of the agricultural program of 1933 were really thinking in terms of income rather than of price—of a ratio of prices received to prices paid that multiplied into quantity of product would give a farm income as good as that of 1910-14 and vary from year to year with the size of the crop. But their arithmetic for figuring parity did not allow for increasing output per worker and per farm over time. Attempts of some of them later to get such an allowance included received recognition in the revised Acts of 1936 and 1938, but it was used only as a basis for distributing the so-called "parity" or supplementary payments for the basic crops. As you explain in your book, parity now means many things to different groups, some even thinking of it in terms of the $900 of farm income per capita as against the $1,800 nonfarm as reported in some government statistics. These are two figures which of course never should be used as a basis for any administrative action. As I have explained elsewhere the major part of the disparity is due to geography, family composition, and other factors.[3] (Have you ever tried, Lauren, to figure out a per-capita farm and nonfarm income for Iowa? If you will, I'll try one for Mississippi.) The Senate report of the group in the Department of Agriculture that undertook to improve the parity formula[4] concluded that income per person had increased about the same farm as nonfarm during the whole period from 1910-14 to 1956, so that income changes could be

[3] *American Economic Review*, March 1956, pp. 26ff.
[4] Document 18, 85th Congress.

ignored, and that ratios of prices received to prices paid shifted from 1910-14 to 1947-56, with 10-year moving-average adjustments thenceforth and by commodities, would suffice so far as furnishing a general standard is concerned. But this report stressed the need for recognizing other factors in setting support prices, one of which could be output per farm and per worker.

The parity-income concept after the war, however, came to have a more specific application, namely, a price support adjusted to the size of the crop so that a large crop will bring about the same gross returns as an average or normal crop. To such prices, the term "flexible" has come to be applied, only to be smeared with the same political paint as Brannan's parity payments, as a result of which we have never had enough of them to have any significant effect. And they were not flexible enough in the Act itself to accomplish their purpose more than part way. And the question still remains as to whether stable net returns or gross returns or a marriage of the two should be their guide.

We have not yet really dealt with agriculture in a major business depression—and I am not now thinking of one as severe as that in 1930-34. The most workable procedure in such a situation is to stop making loans or purchases when the parity ratio falls, in spite of the use of the measures suggested, below a certain level—maybe 75 percent of parity—and let prices of farm products fall to whatever level they will; then make up the difference, in direct payments to the farmers, between the 75 percent for any product and the actual sales price.[5] This same procedure can be used at other times when the price of any one product falls below a specified level, maybe 70 percent, for some particular reason. Such a procedure will not assure the farm family a full-size income during depressions; but neither does employment security assure the urban worker full income during unemployment. It will mean that this country is taking full advantage of all the purchasing power in the market, at home and abroad, which is highly important in depressions.

The foregoing procedure would really be better if it were on a percentage of price times volume of sales (or parity-income) basis instead of just prices, but this would involve more arithmetic and statistics and may meet other objections in some quarters.

We said earlier that any agency of government that is going to administer a surplus-price support program must operate under the direction of a set of guiding principles if it is going to attain its goals. Have we by now outlined such a set with sufficient definiteness? Let us see:

A. First, for all the products except the six basic crops—Set prices at

[5] Of course I am here talking about parity on the old 1910-14 basis, but modernized as between different products.

the market level, this level being defined as what the price would be with the U. S. government not intervening, *except as such prices will be modified by*—

(1) The ever-normal granary operations herein described
(2) Such distribution of farm priducts in the U. S. as has been outlined here, insofar as Congress will authorize it.
(3) Such distribution in other countries as meets the standards here defined.
(4) Buying periodic excess supplies and holding them off the market for a while.
(5) The bottom of 75 percent of parity price or income in depressions, and 70 percent for individual products at other times.

B. For the six basis crops—
What is outlined under A, plus any restrictions on production that prove to be really effective in reducing output. Those thus far employed have mainly been effective only in the short run. They have increased yields on the one hand, and have increased the acreages of nonbasic crops, particularly feed crops, so that there has been an increase in total agricultural output. Tobacco was the slowest of the basic crops to respond in this way, but its final response has been large. Surely some of the controls of quotas in the present laws need revision at the least.

C. Strengthen and expand the agricultural conservation payment program (ACP—I am not sure what it is called now). This means working up and implementing on many farms 5 to 10-year plans for the use of certain fields that should not be cropped during this period both for conservation reasons and because the crops that would be grown are in surplus. The conservation reserve part of the soil bank program should be merged with this ACP program. There needs, of course, to be a simple land-use plan worked up for each of the farms that is included in what is in the nature of the contract with the government.

The general objective of these plans is to *extensify the farming practiced,* that is, reduce the total output per acre of the land in the farms while increasing the net farm income, at least after a few years. In general there are two ways in which this can be done: the first is to reduce cash expenditures more than cash receipts; the second is to get more acres in the farm. (This may even involve selling out and buying a larger farm.) The second will be highly necessary on the lower-income commercial farms. On farms where this is needed but practically impossible, the alternative is more off-farm work by the farmer or members of his family, or quitting

farming altogether. At this level, as explained before, Problem Two overlaps with Problem One.

D. Adapt and expand the whole-farm planning of the Farm and Home Development Program to meet the needs of the foregoing as well as of Problem One.

The adaptation will take on two particular characters; One, it will make its major objective the kind of extensifying of farming that has just been described. This does not mean not adopting new technologies; rather it means selecting those that reduce inputs more than outputs. Second, it will call for selecting for planning analysis, particularly at the outset, typical or modal-type farms that exemplify this problem of extensification and discovering what adjustments they need to meet the extensification requirements. The results obtained from these will furnish guidance to most of the other farmers and to the local administrators of the ACP program. It may well prove necessary to revise the set of ACP payments, and even increase some of them, to put some of the farmers in economic position to divert some of their fields to more extensive uses at least in the shorter run.

E. A, B, C and D should, and in my judgment can, be the real solution to Problem Two. But the hole into which the nation has gotten itself by its mistakes of the past may be so gaping that some additional and emergency measures may be needed in the next few years. Increasing distribution of surpluses at home should be pushed hardest, but it will not be enough. Next should be a selection from the acreage reserve program of some of it that based upon experience this year and next is most effective in the short run without building up too much potential increase in output later, and fits in best with the ACP program; third, should be disposal abroad, through financing with surplus farm products some carefully reviewed economic development undertakings.

* * *

At the end of Chapter 11, you propose setting up an independent farm "price stabilization board," with a status something like that of the Federal Reserve Board in monetary matters. It follows from the foregoing that it would need to allow for some measure of price support as well as of stabilization in its considerations. It would also need to work closely with more other agencies than the Federal Reserve Board, with the administrators of the latest agricultural act, of the federal part of the agricultural extension service, of the Soil Conservation Service and of the Farm Credit Administration and Farmers Home Administrators,

etc., and integrate its schedule of prices to the functioning of these agencies. The great advantage of having such a separate board is that the Secretary of Agriculture and his staff would no longer be primarily responsible for the decisions, and the decision making would be somewhat removed from politics.

You have raised the question of preparedness for war in this connection. The granary program outlined will furnish much of the needed protection in the short run, and the programs of extensifying agriculture and building up conservation reserves will provide a lot of enriched land ready to plow for crops when needed.

* * *

You stress greatly in your book that farmers are at a disadvantage because of the inelasticity of demand for farm products and because the prices at which they sell are not "administered" like prices of most nonfarm products. In consequence, you say, it becomes necessary for government to make the administered farm prices. Let me ask in conclusion, will not a program such as outlined under A to E above establish just about the amount and kind of administration of prices that will be best for agriculture? Given such administration of its prices, will agriculture still be at a disadvantage?

* * *

In conclusion, Lauren, given a program already in operation for dealing with Problems One and Two such as described in the foregoing, would you not feel reasonably hopeful for the future of agriculture? And do you still despair of getting such a program as much as you did at the end of your book?

SELECTION OF PRODUCT LINE FOR A FLUID MILK PLANT BY ACTIVITY ANALYSIS[1]

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ACTIVITY analysis is proving valuable in farm management research. It also has a place in marketing research.[2] This paper illustrates the efficacy of activity analysis in evaluation of adjustment problems facing fluid milk plant managers.

Firm management is continuously faced with problems of resource allocation in an economy in which technology and institutions are changing rapidly. The manager has neither complete planning knowledge nor a procedure that will allow him to utilize rapidly enough what planning knowledge he does possess. Research studies giving figures on average cost over a wide range of firms are of little avail to the manager who is seeking precise cost data for individual products and operations of his particular firm. Moreover, his decisions must be predicated not only on technical operating efficiency but also on market demand and competitive actions of others. Thus, uncertainties exist, not only as to characteristics of input-output ratios but also as to interrelationships of these ratios with factor costs, product returns, given resources and a limited market.

Products, for example, of fluid milk when packaged in paper, require less labor but may take up to three times as much variable capital as when packaged in glass. Manufacture of cottage cheese has a high labor input but production of cottage cheese may be "necessary" to balance the fat-skim ratio. With large labor savings in wholesale delivery of paper containers comes loss of the "safe" retail market for products in glass.

Management decisions relative to the optimum line of products and delivery pattern become exceedingly difficult in this complex of interrelationships. Obviously, plant managers or professional researchers using standard budgeting techniques cannot consider all possible combinations. Activity analysis, however, makes possible selection of the one optimum combination from all the alternatives.

The problem of this study was essentially to determine the optimum product line in a given milk plant, subjecting it alternately to certain of these economic complexes.

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[1] Purdue University Journal Paper No. 1092. Contribution from Purdue Agricultural Experiment Station as a collaborator under North Central Regional cooperative project entitled "Adapting the Marketing Structure for Dairy Products to Changing Patterns of Utilization and Changing Technology."

[2] Charles E. French, "Activity Analysis: An Agricultural Marketing Tool," *Journal of Farm Economics*, Proceedings Number, December, 1955, pp. 1236-1248.

Experimental Method

Much has been written concerning the operating efficiency of distribution of fluid milk.[3] Yet, the literature did not provide all necessary data for activity analysis. Inadequate classification and measurement of factor inputs, and lack of precise data for specific production techniques and products proved especially troublesome. A given plant was used as a case study to refine the data by allowing derivation of input-output coefficients for a representative product line in terms suitable for activity analysis. Some data from the plant were supplemented with information from manufacturers of equipment and supplies, other plant operators and research previously published.

Twenty processes were chosen.[4] Each resulted in a different product, such as wholesale distribution of milk in paper, one-half gallon containers; wholesale distribution in glass, gallon jugs; retail distribution in glass quart containers; etc. All factors of production of the individual dairy firm were assumed to fall into two classes.[5] The first group were limited or scarce factors obtainable at constant variable cost (usually zero) up to a fixed maximum quantity and thereafter not available at all. The second group were unlimited factors available in any desired amount at constant unit cost.

The limited or scarce factors, for the most part, were measured in physical terms. Generally they were limited or fixed in amount for several weeks or months. Some were fixed for a somewhat longer period.

Factors not considered to be limiting on production included management, clerical staff, miscellaneous and fixed plant labor, machinery excepting filling and washing, and building facilities with the exception of the cold room. Certain types of plant labor, machinery, building and management were excluded since these requirements were relatively constant over wide volume ranges of varying products insofar as it was possible to ascertain.

Total plant labor was considered limited as it is customary to hire plant labor for at least a three-year period. Most plant jobs require a training period of one to six months. Plant labor was divided into four departments on the criteria of spatial immobility and specialization of workmen.

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[3] H. M. Kellogg, "The Efficiency of Milk Delivery: The Home Delivery Routeman as a Salesman." Unpublished Master's Thesis, Purdue University, Lafayette, Indiana, 1953.

[4] Limited computational capacity restricted the number of processes which could be chosen.

[5] The peculiar assumptions of this study hinge, to a certain extent, around the assumptions necessary in activity analysis concerning factor supplies and costs. The theory of activity analysis can be found in such references as Robert Dorfman, *Application of Linear Programming to the Theory of the Firm*, Berkeley (1951).

These were: empty bottle and case, processing, fill and wash, and cold room. All labor in each department was considered homogenous.

In the development of coefficients of labor production, only variable labor was included (Table 1). In essence, this labor involves that part of total labor input that varied from product to product in essentially a linear relation.

Total distribution labor was considered limited in that it is customary to hire such labor for at least a two-year period. Most route jobs require a training period of one to nine months. Although certain tasks performed

TABLE 1. VARIABLE LABOR INPUT PER UNIT OF PRODUCT, PLANT AND DELIVERY OPERATIONS, ONE SELECTED FLUID MILK PLANT, INDIANA, 1954[a]

Product[b]	Plant				Delivery
	Empty bottle	Processing	Fill & wash	Cold room	Retail & wholesale
	(Man/minutes)				(Man/minutes)
Gl G H W	.063	.021	1.007	.233	1.246
Qt G H R	.021	.005	.050	.078	.901
½ Pt G H W	.010	.001	.053	.039	.249
½ Gl P H W	.019	.010	.063	.103	.552
Qt P H W	.011	.005	.038	.058	.249
½ Pt P H W	.004	.001	.042	.021	.166
½ Pt G CCr R	.010	.037	.056	.058	.901
½ Pt G CCr W	.010	.037	.056	.058	.415
½ Pt P CCr R	.004	.037	.043	.028	.901
½ Pt P CCr W	.004	.037	.043	.028	.249
Qt P BM W	.011	.053	.067	.073	.415
Qt G Ch R	.021	.032	.090	.097	1.082
½ Pt G Ch W	.010	.008	.055	.047	.311
Qt P Ch W	.010	.032	.067	.073	.415
½ Pt P Ch W	.004	.008	.067	.025	.208
½ Gl P Lf W	.019	.067	.063	.129	.552
Pt P HH W	.006	.093	.068	.039	.249
12 oz. C Ch W	.008	.188	.127	.039	.291
2 lb. C Ch W	.027	.502	.408	.140	1.121
4 lb. C Ch W	.015	1.003	.840	.078	.623
Total available per working day	610	1135	2670	2725	20160

[a] Inputs of plant labor were derived from a time study of plant operations. Labor inputs for delivery were based on 50 Indiana retail milk routes, and 23 Indiana wholesale routes as reported by J. W. Hicks, and G. B. Wood, *Operations in Retail and Wholesale Milk Routes*, Purdue University Agricultural Experiment Station Bulletin 556, November 1950. Although labor inputs for delivery here represent those of "average" retail and wholesale routes, study also was made of labor inputs for numerous variations in route characteristics.

[b] Product symbols may be summarized as follows:

Container size: Gl, gallon; ½ Gl, half-gallon; Qt, quart; ½ Pt, half-pint.

Container type: G, glass; P, paper.

Container content: H, homogenized milk; CCr, coffee cream; BM, buttermilk; Ch, chocolate; Lf, low-fat milk; HH, half and half; CCh, cottage cheese.

Method of delivery: R, retail; W, wholesale.

For example—Gl G H W, gallon, glass, homogenized milk, wholesale delivery.

by the routeman were fixed regardless of volume, delivery labor was generally variable.

Filling and packaging machines were the only machines considered to be limiting (Table 2). Machine capacity in this area tends to be fixed in the short run due to the high initial investment required for glass bottling and, in certain cases for paper packaging. Usually, however, paper-packaging machines are leased from the manufacturer. Rental payments consist of a high fixed charge irrespective of use, and an additional charge per unit packaged.

The cold room was the only part of the fixed input on building considered limiting (Table 2). Recent research indicates that inadequate facilities in cold rooms are common in Midwest dairies. Expense and time involved in alterations of the cold room tend to fix the available storage capacity in the short run.

The study assumed that the operator had developed a supply of milk, the total quantity of which was limited. Physical inputs of fat and skim per unit of product were determined by use of product formulas (Table 2). Unlike other factors, the unused portions of fat and skim were given disposal values since it is common procedure to sell surplus fat and skim at discounted prices.

Total capital for variable expenses was considered limited. Variable capital input[6] per unit of product was calculated for plant and for delivery operations (Table 2). As with other limited, or scarce factors, this capital service or line of credit was obtainable at no cost up to the fixed quantity. Thereafter it was not available at all. The items making up the inputs of variable capital were unlimited and were available in any amount desired at constant unit cost. Total amount of capital (capital service) was limited, not the items for which this capital service was used. Variable capital included only those items whose inputs varied from product to product. All fixed capital expenses, such as depreciation and taxes, that did not vary with change in line of product were excluded.

Product prices and sales volumes of the case plant were used to provide the market limitations. Potential situations in marketing problems in respect to price must consider sloping demand curves, while the demand curve for the individual farm will traditionally be horizontal. This is a major difference in application of this method between agricultural production and agricultural marketing.

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[6] Variable capital includes the following categories: (a) packaging materials (bottles, cartons, cases, etc.), (b) machine rentals and repairs, (c) operating supplies (cleaning, fuel, water and sewage), and (d) manufacturing materials (vitamins, coagulator, chocolate, etc.).

TABLE 2. MACHINE OPERATING TIME, COLD STORAGE REQUIREMENTS, FAT AND SKIM INPUTS, VARIABLE AND DELIVERY CAPITAL, AND NET SELLING PRICES PER UNIT OF PRODUCT, ONE SELECTED CASE-STUDY PLANT, INDIANA, 1954[a]

Product[b]	Machine oper. time	Cold storage	Fat	Skim	Variable plant capital	Variable delivery capital	Variable total capital	Net selling prices
	(Min)	(Sq. in.)	(lbs)	(lbs)	(Cents)	(Cents)	(Cents)	(Cents)
Gl G H W	.320	14.809	.318	8.282	1.451	.439	1.890	52.110
Qt G H R	.017	4.936	.080	2.070	.491	.315	.806	18.193
½ Pt G H W	.017	1.742	.020	.518	.343	.044	.387	4.613
½ Gl P H W	.038	6.582	.159	4.141	3.576	.190	3.766	28.234
Qt P H W	.027	3.702	.080	2.070	1.946	.073	2.019	14.480
½ Pt P H W	.027	1.346	.020	.518	1.153	.022	1.175	3.824
½ Pt G CCr R	.017	1.742	.110	.415	.371	.095	.466	19.535
½ Pt G CCr W	.017	1.742	.110	.415	.371	.044	.415	17.085
½ Pt P CCr R	.027	1.346	.110	.415	1.280	.047	1.327	18.672
½ Pt P CCr W	.027	1.346	.110	.415	1.280	.022	1.302	16.197
Qt P BM M	.027	3.702	.039	2.118	2.146	.073	2.219	14.280
Qt G Ch R	.037	4.936	.040	2.008	3.564	.315	3.879	17.121
½ Pt G Ch W	.017	1.742	.010	.502	1.111	.044	1.155	3.845
Qt P Ch W	.027	3.702	.040	2.008	5.119	.073	5.192	13.308
½ Pt P Ch W	.027	1.346	.010	.502	2.021	.022	2.043	2.956
½ Gl P Lf W	.038	6.582	.066	4.319	7.198	.190	7.388	22.612
Pt P HH W	.027	2.116	.141	.920	2.500	.037	2.537	19.964
12 oz. C Ch W	.025	3.291	.031	3.660	3.580	.037	3.617	16.383
2 lb. C Ch W	.100	11.847	.082	9.761	7.435	.263	7.698	33.419
4 lb. C Ch W	.150	6.582	.164	19.522	5.116	.146	5.262	70.738
Total Available Per Day Working	1586	179,130	2797	72795			90,000	

[a] All inputs, except variable delivery capital, were derived from study of case plant operations and related data. Delivery inputs were based on the Hicks and Woods study, *op. cit.*, p. 25. While capital inputs here represent those of "average" retail and wholesale routes, study also was made of capital inputs for numerous variations in route characteristics.

[b] See Table 1 for definitions.

Solution Framework

Conventional techniques for activity analysis allow us to develop the following set of equations from the data previously derived:[7]

$$
\begin{aligned}
1)\quad & 0.063X_1 + 0.021X_2 + 0.010X_3 \cdots + 0.015X_{20} \leq 610 \text{ minutes}\\
2)\quad & 0.021X_1 + 0.005X_2 + 0.001X_3 \cdots + 1.003X_{20} \leq 1{,}135 \text{ minutes}\\
3)\quad & 1.007X_1 + 0.050X_2 + 0.053X_3 \cdots + 0.840X_{20} \leq 2{,}670 \text{ minutes}\\
4)\quad & 0.233X_1 + 0.078X_2 + 0.039X_3 \cdots + 0.078X_{20} \leq 2{,}725 \text{ minutes}\\
5)\quad & 1.246X_1 + 0.901X_2 + 0.249X_3 \cdots + 0.623X_{20} \leq 20{,}160 \text{ minutes}\\
& \vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots\\
14)\quad & 1.000X_2 \leq 8{,}500 \text{ qt. equiv.}\\
& \vdots \qquad \vdots \qquad \vdots \qquad \vdots \qquad \vdots\\
25)\quad & 1.890X_2 + 0.806X_2 + 0.387X_3 \cdots + 5.262X_{20} \leq 90{,}000 \text{ cets}\\
26)\quad & 52.110X_1 + 18.193X_2 + 4.613X_3 \cdots \quad 70.738X_{20} = \text{MAXIMUM DOLLAR}
\end{aligned}
$$

[7] There were 26 equations in total, some of which had up to 20 variables. Market sales for gallon glass homogenized wholesale and all cottage cheese were restricted by the amount of packaging-machine time available for these products.

In this set of equations, for example, equation one represents our use of labor for empty bottles, equation five our use of labor for delivery, equation twenty-five our use of variable capital, and equation twenty-six represents net selling prices. By maximizing this last equation, we secured maximum returns to our fixed resources.

In the case plant, returns to fixed factors were generally greater for glass than for paper products (Table 3). No half-pint paper products were produced, and half-gallon paper homogenized did not reach the market limit. In contrast, all glass products, excepting the gallon, reached the market limit.[8] In addition, glass machine operating capacity became limiting. The marginal value per minute of machine time was 31 cents (Table 4). Marginal values for additional units of market sales varied from .4 cents for quart paper homogenized to 35.3 cents for retail coffee cream.

TABLE 3. OPTIMUM LINE OF PRODUCTS, BASE SITUATION, ONE SELECTED FLUID-MILK PLANT, INDIANA, 1954

Product[a]	Available market per working day	Optimum product line	Marginal cost above net selling price
	(units)	(units)	(cents/unit)
Gl G H W	229	none	4.4
Qt G H R	8,500	8,500	0.0
½ Pt G H W	12,700[b]	12,700	0.0
½ Gl P H W	6,738	5,585	0.0
Qt P H W	5,800	5,800	0.0
½ Pt P H W	12,700[b]	none	0.3
½ Pt G CCr R	400[c]	400	0.0
½ Pt G CCr W	1,800[d]	1,800	0.0
½ Pt P CCr R	400[c]	none	0.3
½ Pt P CCr W	1,800[d]	none	0.4
Qt P BM W	750	750	0.0
Qt G CH R	375	375	0.0
½ Pt G CH W	7,800[e]	4,566	0.0
Qt P Ch W	1,950[e]	808	0.0
½ Pt P Ch W	7,800[e]	none	0.4
½ Gl P Lf W	463	463	0.0
Pt P HH W	650	650	0.0
12 oz. CCh W	2,920[f]	1,016	0.0
2 lb. CCh W	730[f]	none	10.3
4 lb. CCh W	486[f]	none	16.6
Total net revenue per working day	$5790.09		

[a] See Table 1 for definitions.
[b] Market will take up to 3,175 quart equivalents in glass or paper.
[c] Market will take up to 100 quart equivalents in glass or paper.
[d] Market will take up to 450 quart equivalents in glass or paper.
[e] Market will take up to 1,950 quart equivalents in glass or paper.
[f] Market will take up to 2,920 units 12 ounce, or 730 units 2 pound, or 486 units 4 pound, or some combination of these amounts.

[8] The glass gallon operation was a small, inefficient one and distinct from glass ½ pt.–qt. In our discussion glass products will refer to ½ pt.–qt. only, unless specified otherwise.

High returns to glass products may result partially from retail-wholesale price differentials, since 60 percent of the glass products were also retail products. However, the case for glass products was fairly conclusive in light of the "market-limit" production of half-pint glass homogenized and coffee cream. Also, glass wholesale chocolate predominated over paper wholesale chocolate.

Since this firm had an abundance of resources for the given market and milk supply, it could make substantial changes in product line with-

TABLE 4. OPTIMUM RESOURCE USE, BASE SITUATION, ONE SELECTED FLUID MILK PLANT, INDIANA, 1954

Limiting Factors	Available Quantity	Unused Quantity	Marginal Value
	(man minutes)		(cent/unit)
Labor			
Empty bottle and case	610	18	0.0
Process	1,135	505	0.0
Fill and wash	2,670	276	0.0
Cold room	2,725	38	0.0
Delivery	20,160	509	0.0
Machine running time			
Glass ½ Pt–Qt	480	None	31.1
Glass Gl	73	73	0.0
Paper ½ Pt–Qt	480	264	0.0
Paper ½ Gl	480	247	0.0
Cottage cheese	73	48	0.0
	(sq. in.)		
Cold room	179,130	29,634	0.0
	(lbs.)		
Fat	2,797	None	18.0
Skim	72,795	None	3.3
	(qt. eq.)		
Market[a]			
Qt G H R	8,500	None	3.6
½ Pt Tot H W	3,175	None	2.3
½ Gl P H W	13,476	2,305	0.0
Qt P H W	5,800	None	.4
½ Pt Tot CCr W	450	None	25.5
½ Pt Tot CCR R	100	None	35.3
Qt P BM W	750	None	3.1
Tot Ch W	1,950	None	2.5
Qt G Ch R	375	None	5.2
½ Pt P Lf W	926	None	.5
Pt P HH W	325	None	10.9
Variable capital	90,000 (cents)	23,205	
Total net revenue per working day	$5,790.09		

[a] See Table 1 for definitions. Market sales for gallon glass homogenized wholesale and cottage cheese were restricted by the amount of packaging-machine time available for these products.

out appreciably affecting total net revenue. For example, introduction of gallon glass brought a reduction in total net revenue of $13.36 per day when replacing quart paper and $49.90 per day when replacing half-pint glass. This represented an annual decrease of $4,000 to $15,000, or less than one percent, in total net revenue. Had wholesale chocolate been produced in paper as well as glass, total net revenue would have been reduced by $20.63 per day.[9] An all-paper production of coffee cream brought a reduction of $19.50. These changes imply greater precision than the typical state of management knowledge.

Situations Studied

Once the base situation had been established, the method allowed wide flexibility in studying the effects of various resource and market situations of such a plant. Some problem existed, however, in choice of these resource and market situations. With activity analysis we admittedly get the "one best budget." Proper selection of situations may be more important in many cases, however, than the "one best budget."

In sum, our analysis was concerned with two major problem areas:

1) *Resource limitations.*[10] The problem here is basically one of maximizing short-run returns to particular resource situations. In general, these situations represented priority problem areas in resource limitation now facing firm managers (scarcity of labor and of space in the cold room, for example).
2) *Market problems.* Analysis was also made of certain problems in promotion and in pricing arising from changing technology and from government legislation. In addition, variations in the physical structure of the market were analyzed briefly.

Resource Limitations

Limitations of available cold room, plant labor, and supply of fat and skim illustrate three of the twelve problem situations of type analyzed. Other situations included varying degrees of these limitations as well as limitations in available capital, delivery labor, and fat-skim ratio.

Cold room—28 percent limitation.

Insufficient capacity in cold rooms is common in Midwest dairy firms.

[9] The $20.63 reduction per day in total net revenue occurs with the following production of wholesale chocolate: ½ pt. glass—2,000 units; qt. paper—950 units; ½ pt. paper—2,000 units.

[10] Problems of new resource adaptation were also briefly studied. Situations, essentially illustrative, were analyzed relative to the glass-paper problem. Basically, these are long-run planning problems and from an analytical standpoint call for a somewhat different problem formulation.

Expense and delay in construction often prevent the firm from adjusting to the increasing storage needs arising from an expanding volume.

To approximate problem situations in general storage facing management of plants that are basically similar, except for limited storage space, available storage capacity was reduced to an effective limitation of 28 percent relative to the base situation. All other factors in the base situation remained constant. With this reduction, drastic changes occurred in product and revenue. Loss of revenue approached $700, even after severe product adjustments. For homogenized products, half-pint glass and quart paper were discontinued while gallon paper increased by 1,500 units—bumping against the market limit. A glass-to-paper conversion occurred in the case of coffee cream. Chocolate remained in quart paper. Non-fat came in at half the available market and cottage cheese hit the market limitation with exclusive production of the four-pound carton (Table 5).

Capital—33 percent limitation

Medium-sized firms often experience high capital inputs per unit of product output. Forced to use merchandising techniques similar to large

TABLE 5. OPTIMUM PRODUCT LINE, UNDER VARYING PROBLEM SITUATIONS, ONE SELECTED FLUID-MILK PLANT, INDIANA, 1954

Product[a]	Base	Cold room 28% limitation	Capital 33% limitation	Fat and skim 20% limitation	Market 200% base	Half-and-half vs. coffee cream
Gl G H W	None	None	228	None	None	None
Qt G H R	8,500	8,500	8,500	8,500	8,482	8,500
½ Pt G H W	12,700	None	12,700	12,700	None	12,700
½ Gl P H W	5,585	6,738	6,738	2,073	1,310	6,295
Qt P H W	5,800	None	303	5,800	10,960	5,800
½ Pt P H W	None	None	None	None	None	None
½ Pt G CCr R	400	None	400	400	800	None
½ Pt G CCr W	1,800	None	1,800	1,800	3,600	None
½ Pt P CCr R	None	400	None	None	None	None
½ Pt P CCr W	None	1,800	None	None	None	None
Qt P BM W	750	750	750	750	1,500	750
Qt G CH R	375	375	None	375	750	375
½ Pt G CH W	4,566	None	None	4,566	None	6,766
Qt P CH W	808	1,950	None	808	3,900	258
½ Pt P CH W	None	None	None	None	None	None
½ Gl P Lf W	463	271	None	463	621	663
Pt P HH W	650	650	650	650	1,400	1,550
12 oz. CCh W	1,016	None	None	1,012	2,407	186
2 lb. CCh W	None	None	None	None	None	None
4 lb. CCh W	None	486	486	None	None	None
Total net revenue per working day	$5,790.09	$5,122.08	$5,345.78	$4,799.55	$5,947.17	$5,350.39

[a] See Table 1 for definitions.

firms, medium-sized firms understandably need relatively large amounts of capital relative to volume. In addition, lack of depth in management, and firm size, often make it difficult for the firm to obtain sufficient amounts of capital service. And where this service is available, the rates may be high.

To illustrate changes in resource use and product output under conditions of capital limitations, available capital was reduced 33 percent. Under these conditions, total net revenue dipped 7.7 percent. Changes in product line are summarized as follows: gallon-glass homogenized reached the market limit along with half-gallon paper homogenized. Production of quart-paper homogenized was reduced almost to zero and output of low-fat products and all chocolate products was eliminated. Production of cottage cheese changed to the four-pound carton and reached the market limit (Table 5).

Fat and skim: 20 percent limitation

Two major problems facing plant operators with respect to milk supply are (1) maintaining an adequate supply of milk throughout the entire year and (2) maintaining a desired fat-skim ratio.

Seasonality of milk production obviously complicates the problem of efficient plant operation as surpluses and shortages develop. Shortages result in loss of customers and less efficient use of other resource inputs. Surpluses present costly problems of disposal.

An adequate analysis of this particular aspect of the problem would be extremely difficult using traditional analytical techniques. Since milk comprises such a large proportion of total costs, allocation of the joint cost of fat and skim to individual products will greatly influence the feasibility of their production. Improper allocation seriously distorts an analysis.

Activity analysis allows allocation of the joint costs of fat and skim to be ignored for the most part if the selling prices of products are accepted. Physical inputs of fat and skim were calculated for individual products and the quantity of the milk available was determined. Disposal prices for excess fat and skim—unlike those of other products—represented existing marketing prices.

Thus, the problem of joint costs has been mainly circumvented—if selling prices of products are accepted. To the extent that these prices are determined competitively, consumer demand has made evaluation of the joint products, fat and skim. If management establishes product prices on basis of cost of production, however, this evaluation has been partially made by the processor. Farm milk-pricing formulas can also be evaluated in this scheme.

With a 20-percent reduction in the supply of fat and skim, glass products generally brought higher returns to the given resources than paper products. With few exceptions production of glass products hit the market limit before the milk entered paper. Half-pint paper was not produced in any event. Half-gallon paper was reduced by 3,000 units. Also, a slight reduction was made in cottage cheese to balance the fat-skim ratio (Table 5).

Market Problems

Twelve situations were analyzed to illustrate the possible potential of activity analysis in solution of market problems in the areas (1) of pricing and promotion, and (2) of physical structure of the market. Our discussion will illustrates only two "promotional-problem" situations.

Market 200 percent of base: delivery labor reduced

This situation was felt to be typical of that facing firms located in rapidly expanding communities. As applied to our base situation the available market was doubled for all products, and delivery labor was reduced by five men. All other inputs remained constant. The reduction in delivery labor is often a companion situation due to general scarcity of labor in such a situation. Answers here should be useful in determining product emphasis in promotional programs.

With the relaxation of market restrictions, total net revenue was increased by $157.08 per day. Productwise, coffee cream, buttermilk, chocolate and half and half all hit the 200% market level. Production of cottage cheese doubled—probably because of limited delivery labor. Low-fat milk increased about 50%. Changes in homogenized production centered around elimination of half-pint glass, a great reduction in half-gallon paper and almost 200% increase in quart paper (Table 5).

Thus, increased sales of specialty products brought marked increases in total net revenue. We might question the usual situation, where a major portion of the sales effort is placed on establishing the firm's name and reputation without reference to specific products. Where firms push particular products, emphasis is often placed on specialties. This seems prudent.

Product promotion: Half-and-half vs. coffee cream

Changing consumer preferences in the market was resulting in an increase in half-and-half consumption and a corresponding decrease in consumption of coffee cream. From a firm's viewpoint, was this a desirable trend?

To analyze this problem, it was assumed that half-and-half had completely replaced coffee cream. Thus, coffee cream was omitted entirely

from the product line and half-and-half was forced in at the market limit. This conversion decreased total net revenue by $85.42 per day or somewhat more than 1%. Part of this is explained in terms of increased container costs of the paper half-and-half since coffee cream was packaged in glass. However, revenue differences due to variations in container type would amount to no more than $20.00 per day. Thus, the firm could spend up to $65.00 a day to maintain present sales of coffee cream.

Summary of Major Findings

1. Within a range of $50.00 per day in total net returns, considerable flexibility existed in choice of a product line. Within limits, the long-run profit position might be enhanced by "meeting competition" when a low-returns product threatened the market.

2. Some evidence indicated that in the short run, firms can afford to spend sizeable amounts on increasing product sales. A host of variables are involved here—retaliation by other firms, competitive position in the market, competitive structure of the industry, etc. Of course, the important factor is the increase in net returns per sales dollar.

3. Evidence suggested that resource balance and use are more important than product line. For example, high priority seemed established for studies of labor use in processing of specialty products and in product handling in the cold room.

4. In all cases, restrictions of resource inputs reduced net returns more than proportional to costs. For example certain resource restrictions gave these impressive marginal values: $2,790 per year per additional square foot of capacity in cold room, 59-percent return on working capital, and $7.80 per additional man-hour of plant labor. All were extremely favorable relative to costs.

5. Excess capacity, as a deviation from optimum, was emphasized. For example, a 20-percent reduction in volume handled gave a marginal value per hundredweight of milk, 34 percent above the actual buying price.

Major Findings Relative to Activity Analysis

1. Data necessary for activity analysis can be secured if reasonable research resources are available.

2. Activity analysis will give the optimum alternatives for short-run situations. Variation in product line by products can be given as resources change. A limitation on cold room, for example, suggested an increase in large-size and paper containers. Also, maintaining specialty output (excepting low fat) at the expense of homogenized can be analyzed in terms of dollar returns. Similar specific evaluation of capital, labor, milk, and market limitations are possible.

3. The practical worth of the technique for selecting the optimum

alternative is somewhat difficult to evaluate. Under certain resource situations, the manager could probably approximate the optimum line without activity analysis. Certain products had the persistent habit of occurring in all or almost all of the optimum-product combinations. Glass retail homogenized, quart paper homogenized, glass coffee cream and quart-paper buttermilk were examples. In general, a total net revenue variation of $25 to $50 per day gave considerable flexibility in product line.

Although product line can be varied considerably without substantially affecting total net revenue once the basic output pattern is established, without use of activity analysis the manager may have difficulty in determining the general pattern of production that maximizes profits. In many of the situations analyzed in this study only one or two resource inputs were limiting. In the field, there would probably be several limiting ones. Here it seems beyond the comprehension of the manager to come up with the one best line.

4. Useful information for certain market problems can be secured. This area was not investigated thoroughly, although useful answers were obtained for several typical problem situations in product pricing and product promotion.

5. Although the emphasis in this study was on short-run profit position, valuable information was obtained for long-run planning. Marginal data were secured for changing volumes of inputs and products.

ESTIMATION OF RESPONSE RELATIONSHIPS FOR EGGS

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Introduction

THIS study is concerned with estimating the short-run price-consumption relationships for eggs. At the outset it is realized that any statistical method of estimation derives its meaning and area of applicability from the concept of a well defined sampling model. In many cases the restrictive nature of economic data obtained from passive observation suggests that observations generated from a controlled experiment are necessary to reflect the variables specified in the model. In this study a randomized block design in conjunction with a factorial arrangement of treatments is chosen to generate the data for the specified models. By use of these data short-run price-consumption relationships are estimated for all eggs, grade AA, grade A and B and non-grade eggs. Each of the relationships is subjected to an economic interpretation and the uses and implications of the results for decision making are discussed.

General Problem Area

In a general operational sense, research in quantitative economics has a threefold basis: first to formulate economic hypotheses, second to collect appropriate data and third to confront hypotheses with data.[1] In this research, economic theory, statistical data and the modern methods of statistical inference combine to provide the tools for estimating the parameters of economic relationships. Given these tools as the foundation stones upon which estimation is to proceed, it is of paramount importance to realize that any statistical method of estimation derives its meaning and area of applicability from the concept of a well defined sampling model.[2]

Most of the studies concerned with the estimation of the parameters of economic behavior relationships have used time series data for which the sampling is performed by the historical course of economic phenomena, outside of the investigators influence. With this type of data such terms as "unbiased estimate," "standard error of estimate," etc. have a meaning only in relation to an imagined sampling process. Recent work

[1] J. Marschak, "Statistical Inference in Economics" Contained in the *Statistical Inference in Dynamic Economic Models*, New York: John Wiley and Sons, 1950, p. 1.

[2] T. C. Koopmans and W. C. Hood, "Estimation of Simultaneous Economic Relationships" Contained in *Studies in Econometric Methods*, New York: John Wiley and Sons, 1953, pp. 113-14.

in econometrics has stressed the importance of adapting statistical methods to the peculiarities of the data and the objectives of economic research. In spite of these advances the investigator is constantly confronted with the questions: (1) have we observed what we meant to observe, and (2) do the true variables actually have the properties of the theoretical variables?[3]

Given these restrictions, observations generated from controlled experiments appear as a logical alternative. If one examines some of our current economic theories, it is apparent that in order to test many of these theories, experimental data will be required.[4] In addition, when an economist specifies a system of relationships he usually has in mind some experimental design which could be arranged in order to measure those quantities in the real economic world that potentially might obey the restrictions imposed on their theoretical counterparts. On the basis of a set of observations generated by this scheme and the assumed known form of the function connecting the variables, it is then possible to estimate the parameters of the functional relationship and the parameters of the distribution of the residuals.

These considerations point up the importance, in quantitative economic research, of considering the conditions under which the observations are produced before identifying them with the variables of a particular theoretical model. It also suggests, as a means of coping with the data problem, the possibility of experiments or controlled measurements designed to obtain the real vartables for which the investigator thinks his model would hold if other influences were artificially isolated.

Specific Problem Area

Within the framework discussed under the general problem area, the major objective of this study will be to employ observations that were generated from a controlled experiment in estimating the parameters of the short-run price-consumption relationships for eggs. The specific objectives delineated include: (1) estimation of the short-run price-consumption relationship of all eggs, and (2) estimation of the short-run price-consumption relationships for eggs by grades.

A corollary objective is the investigation of the practicability of employing controlled experiments as a means of generating data from which short-run price-consumption relationships may be estimated. This study may also be of value in bringing to the attention of economic model

[3] T. Haavelmo, "The Probability Approach in Economics," *Supplement to Econometrica*, 12:14, 1944.

[4] M. A. Gershick and T. Haavelmo, "Statistical Analysis of the Demand for Food," *Econometrica*, 15:92-94, 1947.

builders the fruitfulness of specifying an attendant design of experiment for their theoretical constructs.

Economic Model

As a basis for estimating the parameters of a short-run price-consumption relationship for eggs, a model describing the reactions of consumers when price is included as an artificially isolated factor in their set of decision criteria is postulated as follows:

$$y_t = f(p_t, z_t; \alpha_1, \alpha_2 \ldots \alpha_k) + u_t \qquad (1)$$

where y_t represents the t^{th} observation of quantity disappearance of either all eggs or a particular grade, per 100 customers, p_t the price of eggs in t^{th} observation, z_t all other predetermined variables, $\alpha_1, \alpha_2 \ldots \alpha_k$ are the constants to be estimated and u_t is a random residual. The economic meaning of u_t is that, given a set of prices, consumers do not behave in the same way either because other relevant variables were omitted from control or that individuals are not always consistent in their behavior.

The Experimental Design

In general, an investigator has a large selection of alternative designs from which to choose. In economic research, the complexity of the phenomena suggests in many cases the use of one of the incomplete block designs. In some instances, however, the experimental conditions may be suited to one of the simpler designs such as the latin square or randomized blocks. Of these, the latin square design provides a logical choice since it combines simplicity with a large measure of control. This design has been used successfully by Godwin, Dominick and others in similar research.[5]

Despite the advantages of the incomplete block and latin square designs, a randomized block design in conjunction with a factorial arrangement of treatments was used in this study, largely as a consequence of administrative restricitons. The use of this design defines the following model:

$$y_{ijk} = m + p_i + g_j + r_k + e_{ijk} \qquad (2)$$

where y_{ijk} represents the consumption of eggs in dozens per 100 customers, m the overall mean effect, p_i the price effect, g_j the grade effect, r_k the price grade interaction and e_{ijk} the experimental error.

[5] M. R. Godwin, *Consumer Response to Varying Prices for Florida Oranges*, Fla. Expt. Sta. Bulletin 508, 1952. B. S. Dominick, *Methods in Research*, Cornell Agr. Expt. Sta. Marketing Paper Number 2, 1952. A. W. Jasper, *Increasing Sales of Fresh Fryers Through Improved Merchandizing Practices*, Cornell Agr. Expt. Sta., A. E. 954, 1954. C. H. Berry, et al. *The Demand for Fluid Skim Milk*, Conn. Agr. Expt. Sta. Bulletin 325, 1956.

The Setting

Because of the importance of urban areas of the economy in generating demand for agricultural commodities, Tulsa, Oklahoma was chosen as the sampling area. Such a choice permitted the sample to include a wide range of income classes, families of varying size, diverse racial and religious factors, etc. Within the city, eleven large, modern, self-service markets operating under the management of a single prominent chain of retail outlets were selected in such a manner that sampling took place throughout the entire city. The stores also possessed the advantage of sharing a common source of supply of eggs. The sales of eggs through these stores consisted of the three top grades as determined by USDA standards, (AA, A, B) in the large size only and a non-graded egg. Friday and Saturday of each week during the months of July and August 1956, was selected as the observation period. The eggs were displayed in refrigerated cases in accord with normal practices and price placards were affixed to the case in front of each grade. A rotational scheme was exercised in order to minimize the bias due to the location of a grade of eggs in the display case. In total, nine pricing treatments were applied in which the prices of grade AA, A, B and non-graded were varied over ranges of 55-69, 48-62, 41-55 and 36-55 cents per dozen respectively. Three of the treatments were designed to measure the change in consumer responses for the various grades of eggs under a uniform price level rise. Three other pricing treatments were designed to measure consumer responses for grade AA and A when the price of the respective grade varied and the prices of other grades remained constant.

Empirical Results

It is now in order to confront the postulated models with the data generated by the controlled experiment. In the following section each of the postulated models will be estimated and subjected to economic and statistical tests and interpretation. In each case where short-run price-consumption relationships are estimated, it should be kept in mind that the results pertain to response relationships facing retail outlets and do not indicate what is classically thought of as the demand for a product. Also it should be kept in mind that inferences drawn refer only to the geographical area represented by Tulsa, Oklahoma.

Response relationships for all eggs

In order to obtain parameter estimates of the short-run price-consumption relationships for all eggs, alternative groupings of the treatments were utilized. Initially consider the situation reflected by treatments involving a uniform increase in price level (constant price differential

between grades and a linear increase in price between treatments). As a basis for deriving an estimate of the parameters connecting the variables purchase of eggs and price, a linear model was postulated. Estimation of this linear model resulted in the following regression equation:

$$y_1 = 33.91 - 0.2757\ z_1 \qquad (3)$$
$$(0.1808) \qquad R^2 = 0.70$$

where y_1 represents the total purchases of eggs in dozens per 100 customers and z_1 represents the average price of eggs per dozen. Standard errors of estimate appear in parentheses below the coefficient. The sign of the coefficient agrees with logic in that as the price of a superior good rises the consumption declines. The use of equation (3) results in an estimate of the price elasticity of retail demand at the means of the variables, of −0.73. By utilizing the extreme coordinates of the function, within the confines of the data, price elasticity of demand yielded estimates of −0.96 and −0.60.

As an alternative specification for the price-consumption relationship for all eggs, observations generated by all treatments were utilized. This specification thus involved data generated by changes in the level of price and a change in the price of one or two grades of eggs. A linear model connecting egg purchases and price was postulated based on these data. Estimation of this model resulted in the following regression equation:

$$y_1 = 45.07 - 0.4764\ z_1 \qquad (4)$$
$$(0.1072) \qquad R^2 = 0.80$$

where the variables take on the same definitions as in equation (3). Again the sign of the coefficient agrees with logic. A point estimate of the price elasticity of retail demand at the means of the variables is −1.15. The extreme price and quantity coordinates of the function yielded price elasticity of retail demand estimate of −1.22 and −0.91.

Since past prices might be an additional source of information for purposes of decision making, a model linear in the variables and utilizing, in addition to average price per dozen (z_1), the difference between the average price per dozen in time period t and the average price per dozen in time period t-1 (z_2), was estimated with the following result:

$$y_1 = 45.77 - 0.4829\ z_1 - 0.0873\ z_2 \qquad (5)$$
$$(0.1340) \quad (0.0271) \quad R^2 = 0.93$$

This relationship reflects an estimate of the price elasticity of retail demand at the mean of −1.19. Utilizing extreme values of the function resulted in elasticity estimates of −1.26 and −0.93. This relationship calls attention to the impact of past prices on the purchase of eggs in time period t.

In summary, it should be noted that the signs of the coefficients are consistent with the theory underlying each model. As might be expected by the nature of the data used, price elasticity estimates from models (4) and (5) differ from that of (3) in terms of magnitude. The appropriate choice among models would be conditional upon the conditions that are attempting to be reflected.

Price-Consumption Relationships by Grades

In many cases, knowledge of the price consumption relationships for all eggs is not sufficient. For certain economic considerations, a knowledge of the response relationships by grade is required. As has been mentioned earlier, certain of the treatments were designed to isolate the response relationships for AA-grade and A-grade eggs. These treatments were designed to obtain the reaction of purchasers to alternative prices for a given grade when all other prices are held constant. Consequently the response relationships derived are subject to only one set of prices for the other grades and should be interpreted with this restriction in mind.

Response relationships for AA-grade eggs

In order to estimate a response relationship for AA-grade eggs, data generated by the relevant treatments were employed. A linear model utilizing these data connecting the purchases and price of AA-grade eggs was postulated. Estimation of this model resulted in the following regression equation:

$$y_2 = 6.70 - 0.0693\ z_4 \qquad (6)$$
$$(0.0136) \qquad R^2 = 0.96$$

where y_2 represents the consumption of AA-grade eggs in dozens per 100 customers and z_4 represents the price of AA-grade eggs in cents per dozen. The sign of the coefficient connecting purchases and price agrees with economic preconception. Use of this relationship results in a point estimate of the price elasticity of retail demand at the mean of -1.78, therefore, implying an elastic response to price for this commodity. Use of the extreme coordinates of the function yielded price elasticity of retail demand estimates of -2.49 and -1.32. Although the study was not designed to ascertain the degree of competition among grades of eggs, the data generated by these three treatments did indicate a substitution of grade A for grade AA eggs as the price of the latter increased.

Although it cannot be considered a demand relationship in the classical sense, it may be of interest to present an estimate of the response relationship for AA-grade eggs generated by the treatments of price level. In these treatments the prices of all others were not held constant

as in the previous analysis. Use of these data with a linear model resulted in the following regression equation:

$$y_2 = 6.43 - 0.0729\ z_4 \qquad (7)$$
$$(0.0107) \qquad R^2 = 0.98$$

It is interesting to note the agreement in the magnitude of the coefficients connecting y_2 and z_4 in equations (6) and (7). Although the rate of change between the two variables is approximately the same for the two equations, there is a difference obtained in the level of purchase. Therefore equation (7) resulted in a price elasticity of retail demand estimate of -2.26.

Response relationships for A-grade eggs

As the basis for estimating a response relationship for A-grade eggs, data generated by the remaining treatments were employed. Given these data a model linear in the variables purchases and price was postulated. Estimation of this model resulted in the following regression equation:

$$y_3 = 22.62 - 0.2286\ z_5 \qquad (8)$$
$$(0.0388) \qquad R^2 = 0.97$$

where y_3 repreesnts the consumption of grade A eggs in dozens per 100 customers and z_5 represents the price of grade A in cents per dozen. Again, the sign of the coefficient connecting the two variables agrees with logic. Use of this relationship results in a point estimate of the price elasticity of retail demand at the mean of -1.25, again implying an elastic response to price elasticity of demand estimates of -1.69 and -0.94. Although additional data would be necessary to test the extent of substitution among grades as price ratios change, the data generated by these treatments did lend credence to the hypothesis that B and no-grade eggs are substituted for A-grade eggs when the price of the latter increases.

As in the case of grade AA it may be of interest to consider the response relationship for grade A reflected by the price-level treatments. Again, attention is called to the fact that the prices of the other grades of eggs were not held constant in these treatments. Use of these data with a linear model resulted in the following regression equation:

$$y_4 = 24.57 - 0.2571\ z_5 \qquad (9)$$
$$(0.2078) \qquad R^2 = 0.60$$

Again, it is interesting to note the agreement in the size of the coefficients connecting the variables in equations 8 and 9. Equation 9 resulted in a price elasticity of retail demand estimate at the mean of -1.17. Using the extreme coordinates of the data yielded price elasticity estimates of -2.05 and -1.08.

Response relationships for B and no-grade eggs

Although the study was not specifically designed to measure the response relationships for B and no-grade eggs it may be instructive at this point to use the data generated by the experiment to obtain an estimate of this relationship. Since there is some indication that A grade eggs substitute for B and no-grade eggs under certain price conditions, a model linear in the variables connecting these prices and the purchases of B and no-grade eggs was postulated. Estimation of this model resulted in the following regression equation:

$$y_5 = 8.49 - 0.1680\, z_6 + 0.1380\, z_5 \qquad (10)$$
$$\qquad\qquad (0.0627) \quad (0.0548) \quad R^2 = 0.67$$

where y_5 represents the aggregate consumption of B and non-graded eggs in dozens per 100 customers, z_5 the price of grade A eggs in cents per dozen and z_6 the average prices of B and non-graded eggs in cents per dozen. Because of the underlying experimental design no strong inferences are possible from the above relationship. However, the signs of the coefficients connecting the variables are consistent with the theory underlying the model. Use of this relationship yielded a crude point estimate of the price elasticity of -0.8125 and a price elasticity of substitution estimate of 0.8205. This relationship implies an inelastic response to price for these grades and indicates the impact that the price of a substitute good (grade A) has upon the purchases of these grades.

Implications of the Results

Although this study was exploratory in nature and a final invariant statement regarding the results is impossible, certain conditional inferences based on the estimated relationships may be warranted at this time. If it can be assumed that the estimates given in the preceding section are accurate portrayals of the parameters of the postulated models, then they provide a basis for analyzing the impact of alternative courses of action, by the government and by the firm. From the level of economic policy the retail price elasticity parameter estimates for all eggs may be used to gauge the impact of total supplies on total revenue. However, here it should be remembered that these estimates apply to only a restricted geographical area and consumer responses refer to purchases at retail outlets.

At level of the firm the estimated relationships have many uses in the area of decision making. First assume that a certain retail organization is the sole supplier of eggs for a restricted geographical area and that its objective is one of maximizing profits. Under this condition, equations (3) or (4) could be converted to an average revenue function and

given the cost of producing eggs the firm could then estimate the price and quantity of eggs that would make profits a maximum. Alternatively these equations can be used to gain an answer to the problems: (1) given a certain quantity of eggs to be sold, what price should be charged in order to equate supply with demand and (2) given a certain price to be charged for eggs at the retail level, how many eggs should be purchased to fulfill the demands of consumers. Analyses similar to that for all eggs could be made by grades.

Although this study was exploratory in nature from a methodological standpoint it does lend credence to the application of controlled experiments as an operational procedure in deriving short-run price-consumption relationships. Because of administrative restrictions, it was impossible to use what was *a priori* believed to be the optimum design. For partial preference analysis however, the latin square design suggests itself as a worthy candidate. On the other hand partial preference analysis may be invalid in view of the interactions that might result from the simultaneous treatment of several factors (such as size, grade and color). Since the number of treatments under this situation proves to be large, an incomplete block design may be indicated as necessary.

DETERMINING LEAST-COST COMBINATIONS*

R. H. McAlexander and R. F. Hutton

THE MAIN interest of agricultural workers in linear programming to date has been in problems of the maximizing type. The problems in mixing feed and fertilizer have been an exception. Waugh's[1] treatment of the problem of feed mixing was in terms of general matrix algebra. Since his work appeared the problem procedure has been reduced to a routine that has the advantage of making the method available to persons unfamiliar with general matrix algebra. Swanson,[2] and Fisher and Schruben[3] discussed their results without revealing the method of problem formulation. Katzman[4] gave one problem formulation and Hutton and Allison[5] another in setting up similar types of problems.

In this note we wish to discuss several methods of setting up the least-cost (minimization) type of problem and some of the advantages of each. The general methods used in formulating the various minimization models are presented by Charnes, Cooper and Henderson.[6] We hope to relate the minimization form to the maximization form in such a way that those who have worked only with the maximization form of problem will be able to follow the presentation.[7] Our examples of various methods of setting up least-cost problems are such that they can be solved by the same set of rules used for maximization problems.

Maximizing Physical Output From a Given Outlay

The most straightforward way of setting up the minimization problem is to convert it into a logical maximization problem. If we can find the solution that maximizes physical output for a given amount of resources, we have found the least-cost solution.

* Authorized for publication on April 16, 1957 as paper No. 2144 in the Journal series of the Pennsylvania Agricultural Experiment Station.

[1] F. V. Waugh, "The Minimum-Cost Dairy Feed," *Journal of Farm Economics*, Vol. 33, August 1951, pp. 299-310.

[2] E. R. Swanson, "Solving Minimum-Cost Feed Mix Problems," *Journal of Farm Economics*, Vol. 37, February 1955, pp. 135-139.

[3] Walter D. Fisher, Leonard W. Schruben, "Linear Programming Applied to Feed Mixing Under Different Price Conditions," *Journal of Farm Economics*, Vol. 35, November 1953, pp. 471-483.

[4] I. Katzman, "Solving Feed Problems Through Linear Programming," *Journal of Farm Economics*, Vol. 38, May 1956, pp. 420-429.

[5] R. F. Hutton and J. R. Allison, "A Linear Programming Model for Development of Feed Formulas Under Mill-Operating Conditions," *Journal of Farm Economics*, Vol. 39, February 1957, pp. 94-111.

[6] See A. Charnes, W. W. Cooper and A. Henderson, *An Introduction to Linear Programming*, New York: John Wiley and Sons, 1953.

[7] For a discussion of the relationship between the maximization and minimization problem see Charnes, Cooper and Henderson, *ibid.*, pp. 31-33.

To formulate the problem in this manner merely requires that a positive quantity be entered in the P_0 column. The cost per unit of activity represented by each column vector is entered on the same row that is occupied by the row in the tableau having the positive P_0 entry indicated above. One column vector will represent the job to be done. It will have a zero entry on the above described "cost row" of the tableau but will have the only non-zero "c" value of the processes in the tableau. The solution will then maximize the output of this process representing the job to be done within the limits set by the restriction on outlay.

To illustrate this and other methods we will use the following problem. We wish to choose the least-cost combination of "hay" and "grain" needed to satisfy the nutrient allowance of a 1000-pound dairy cow giving 8000 pounds of four per cent fat corrected milk. The feed specifications are (a) at least 6,020 pounds of total digestible nutrients and (b) at most 9,125 pounds of dry matter.[8] On a ton basis, the hay is estimated to furnish 942 pounds of total digestible nutrients and 1,621 pounds of dry matter.[9] Each ton of grain is estimated to furnish 1,554 pounds of total digestible nutrients and 1,788 pounds of dry matter.[10] The hay costs $30 per ton; the grain $50 per ton.

To set this problem up in the manner described above, we need to know the restriction on outlay and the net revenue from feeding a cow. These can, however, be arbitrarily chosen so long as they are positive. From the solution obtained, a ratio of hay to grain can be developed to be used in planning the least-cost program for cow feeding. In this problem we will assume that outlay is restricted to $100 and "net revenue" per cow is $1. Table I gives the first tableau for this type of problem statement.

This problem will result in a maximum use of P_4. The level of P_4 in the solution (and the $z_0 - c_0$ value also since $c_4 = 1$) will indicate the number of cows (or fractional part of a cow) that can be fed for an outlay of $100. The remaining processes in the solution will indicate the tons of each feed that will be purchased. This answer can then be scaled to obtain the least-cost feed combination per cow.

The chief merit of this method is its similarity to the usual maximiza-

[8] Total digestible nutrient allowance is based on data from National Research Council, "Recommended Nutrient Allowances for Dairy Cattle," August, 1945, p. 4. Upper limit on dry matter intake is on the basis of 2.5 pounds of dry matter daily per 100 pounds of liveweight.

[9] Total digestible nutrient and dry matter quantities for hay are for clover and timothy hay adjusted for 8 per cent feeding loss and are based on data from F. V. Morrison, *Feeds and Feeding*, Ithaca, New York: The Morrison Publishing Company, 1948, 21st edition, Table 1, p. 1088.

[10] Total digestible nutrient and dry matter quantities for grain are for barley, *ibid.*, Table 1, p. 1114.

TABLE I. FIRST TABLEAU OF A COST-MINIMIZATION PROBLEM SET UP TO MAXIMIZE PHYSICAL OUTPUT FROM GIVEN OUTLAY*

cj→ ↓		P_0	0 P_1	0 P_2	0 P_3	1 P_4	0 P_5	0 P_6
0	P_1	100	1	0	0	0	30	50
0	P_2	0	0	1	0	+6,020	−942	−1,554
0	P_3	0	0	0	1	−9,125	1,621	1,788

* P_1=outlay disposal; P_2=TDN disposal; P_3=dry matter disposal; P_4="cow" vector (i.e. the job to be done); P_5=hay; and P_6=grain.

tion problem. A serious disadvantage is that the costs of the inputs are within the main body of the tableau. This means that an entirely new solution must be obtained for each cost change. As will be demonstrated later, if the costs are carried as negative "c" values, the solution for a new set of prices may begin with the solution tableau of a previous problem. A further disadvantage is that degeneracy is encountered on the first tableau. However, this is easily resolved and is of trivial consequence.

Maximum Net Revenue from Fixed Capacity

Costs can be stated as negative "c" values and some arbitrary or real restriction can be placed upon the capacity to perform the job. For example, we could assume that capacity in the previous illustration is in terms of one cow. This restriction is entered in the P_0 column. The "cow" vector, P_4, is now modified to indicate a requirement of one unit of capacity per unit level of the process. The costs of hay and grain are expressed as negative "c" values. In this case the "c_4" value may be arbitrarily chosen but it must be a positive number in excess of the cost of the feed for the cow. If this were not so, entry of "capacity disposal" to the full limit of capacity available would be the optimum solution. Thus, P_4 may be given a large positive value such as 1,000.[11] The first tableau of the illustrative problem set up by this method is given in Table II. The

TABLE II. FIRST TABLEAU OF A COST-MINIMIZING PROBLEM SET UP TO MAXIMIZE OUTPUT SUBJECT TO CAPACITY RESTRICTIONS*

cj→ ↓		P_0	0 P_1	0 P_2	0 P_3	1,000 P_4	−30 P_5	−50 P_6
0	P_1	1	1	0	0	1	0	0
0	P_2	0	0	1	0	6,020	−942	−1,554
0	P_3	0	0	0	1	−9,125	1,621	1,788

* P_1=capacity disposal; P_2=TDN disposal; P_3=dry matter disposal; P_4="cow"; P_5=hay and P_6=grain.

[11] Another way of handling this is to put a large negative "c" value on capacity disposal. This has the merit of permitting the "$z_0 - c_0$" value in the final solution to reflect directly the cost of the feed.

solution will obviously consist of one unit of P_4. The other vectors will enter at levels sufficient to meet the feed requirements of the cow. The level of entry of P_5 and P_6 will be tons of hay and grains, respectively, needed to feed the cow at least cost. The feed cost will be the "$z_0 - c_0$" of the solution tableau minus 1,000, the artificial "c" value assigned to P_4. The difference will be a negative quantity which indicates a cost.

This formulation has all of the merits of that shown in Table I plus additional advantages. The costs are carried outside the main body of the tableau. Thus, adjustment for change in cost of inputs is facilitated. The chief merit of both this and the previous method is that other jobs of a similar character can be included in the same tableau. For example, if we wished to solve for the least-cost combination of hay and grain for a cow of different production level, we could merely add a vector similar to P_4 whose coefficients reflected the necessary changes in feed allowances. We could then block one of these vectors by giving it a large negative "c" value.[12] The coefficients in the solution tableau for the blocked vector would indicate how the ratio of feeds should be modified to meet the needs of the cow represented by the blocked vector.

Obtaining Least-Cost Solution Starting From a High-Cost Artificial Solution

The actual requirements of the job may be stated in the P_0 vector. This will eliminate one row and two columns from the previous formulations. However, some difficulties are encountered in this procedure.

In setting up the equations that precede the development of the tableau, it is not always possible to get both the left hand term of the equation and the coefficient of the row disposal process both to be positive. Since the left hand member is to become the P_0 element for the row, it needs to be positive unless we wish to use a different set of solution rules. The disposal process having a negative coefficient logically cannot be a part of the initial simplex solution. The entry of the disposal process with negative coefficient would augment rather than "dispose of" the quantity in the P_0 column.

To get around this problem, artificial vectors and artificial prices for these vectors may be used.[13] In minimization problems these vectors are artificial sources of the requirement given in the P_0 column. The artificial vectors replace the disposal processes having negative coefficients in the solution of the first tableau. Of course, the disposal processes must also

[12] The assignment of large negative numbers to vectors is discussed in A. Charnes, W. W. Cooper and A. Henderson, *op. cit.* pp. 15-18.

[13] The use of artificial vectors and prices is discussed by A. Charnes, W. W. Cooper and A. Henderson, *op. cit.* pp. 15-18 and footnote 36, p. 33.

be carried in the tableau, but they do not appear in the initial solution. Since the artificial vectors can serve only in a mathematical sense as sources of requirements, provision must be made to prevent their entry into the final solution. This is done by assigning them a very high cost. The initial solution represented by the first tableau will be very high cost. True feeds are less expensive sources of the requirements. Thus the true feeds enter until the cost of meeting the requirements is reduced no further. The "$z_o - c_o$" value will still be negative when solution is reached but the value will be the maximum attainable in the problem. This, of course, will be the cost of the feed.

Table III shows the first tableau of the illustrative problem set up according to the method described above.

Note that P_5 is in the initial solution. The cost of P_5 is \$1 per unit. The initial solution thus costs (\$1 × 6,020) or \$6,020. Obviously, this cost can be reduced by use of true feeds.

TABLE III. FIRST TABLEAU OF A COST-MINIMIZATION PROBLEM EMPLOYING ARTIFICIAL VECTORS*

cj→ ↓		P_0	0 P_1	0 P_2	−30 P_3	−50 P_4	−1 P_5
−1	P_5	6,020	−1	0	942	1,554	1
0	P_2	9,125	0	1	1,621	1,788	0

* P_1=TDN disposal; P_2=dry matter disposal; P_3=hay; P_4=grain; P_5=artificial source of TDN.

This method yields a tableau about two-thirds the size of the previous one for the illustrative problem. This probably overstates the advantage usually encountered. Each "at least" requirement in the problem calls for an "artificial" vector. In most minimization problems there will likely be more "at least" than "at most" requirements whereas the illustrative problem has one of each.

This formulation cannot carry directly the specifications for other jobs as the formulation given in the previous section. However, the solutions obtained can be modified by appropriate vector manipulations.[14]

Simplification of the Method of Reducing Cost of a High-Cost Artificial Solution

The inclusion of the P_5 column vector in the above tableau served two purposes. One was to facilitate the exposition. The other was to provide assurance that degeneracy could be resolved. The first reason does not

[14] See R. F. Hutton and R. H. McAlexander, "Simplified Feed-Mix Model," *Journal of Farm Economics*, Vol. 39, August 1937, pp. 714-730.

justify its retention in the original tableau. The second probably does not either. The likelihood of the occurrence of degeneracy that cannot be resolved on the other vectors is very remote. Even if it does occur it can be resolved on an arbitrary basis and solution can continue.

If we are willing to resolve degeneracy on an arbitrary basis (if it occurs), we can simplify the problem statement still further. The rules to follow in this case are very simple. First set the tableau up as usual with all positive P_0 values. Then, if any disposal coefficient is negative, assign a large negative "c" value to the row in which it appears. That is all that is strictly necessary. The P index of the row assigned the large negative "c" value does not apply, but this error is self correcting since a new process will enter this row before solution is reached. Table IV gives the first tableau of the illustrative problem set up by this method. It is the same as that given in Table III except that column P_5 has been deleted, and P_5 removed from the initial solution. The P_1 index in the first row has been lined out to indicate that it does not constitute part of the initial solution. The saving in problem size from using this simplification increases with the number of "at least" restrictions.

TABLE IV. FIRST TABLEAU OF A COST-MINIMIZATION PROBLEMS FROM WHICH ARTIFICIAL VECTOR IS OMITTED*

$c_j \rightarrow$			0	0	−30	−50
↓		P_0	P_1	P_2	P_3	P_4
−1	P_1	6,020	−1	0	942	1,554
0	P_2	9,125	0	1	1,621	1,788

* P_1 = TDN disposal; P_2 = Dry matter disposal; P_3 = hay; P_4 = grain.

CROP ALTERNATIVES TO COTTON IN THE ARKANSAS-MISSISSIPPI "DELTA"—A PROGNOSIS*

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IN 1949, more than ten per cent of the nation's cotton crop came from the Arkansas-Mississippi "delta" (State Economic Areas 8a and 1 respectively). It is often held that areas of this type have a comparative advantage in the cultivation of cotton *vis a vis* "upland" cotton areas, and that, with the absence of acreage allotments and price supports, cotton production would tend to concentrate in this area as a consequence of competitive elimination of "upland" cotton production.

This paper studies the comparative advantage of cotton *within* the "delta" area with respect to two alternate crops: soybeans and corn, and considers three types of influences:

(1) the effect of rising wage rates occasioned primarily by the large-scale departure of much of the area's agricultural labor force,

(2) the relative effect of supplemental irrigation upon the three crops mentioned, and

(3) the effect of a downward shift of the price of cotton relative to corn and soybeans.

Estimates of Revenue per Acre

Estimates of physical yield have been set arbitrarily at ½, ¾, 1, 1¼, and 1½ bales per acre. It is assumed that yields for the alternate crops would vary linearly at a given proportion of cotton yields. Estimated crop yields on land yielding one bale of cotton lint per acre are expected to yield either 20 bushels of soybeans or 40 bushels of corn.

Using the following scale of relative commodity prices

Cotton	$ 0.330 per pound
Cottonseed	64.00 per ton
Soybeans	2.50 per bushel
Corn	1.35 per bushel

revenue per acre of land capable of producing one bale of cotton per acre would be:

Cotton and cottonseed[1]	$193.00 per acre
Soybeans	50.00 per acre
Corn	54.00 per acre

* This paper grows out of a study in economic development made possible by the Rockefeller Foundation. The writer is especially indebted to Grady B. Crowe for his detailed and painstaking examination of a preliminary manuscript. In addition, John M. Brewster, James A. Ford, E. L. Langsford, William H. Nicholls, and Anthony M. Tang have provided helpful comments and ideas.

[1] Lint $165, cottonseed $28. Cottonseed weight assumed to be 175 per cent of the weight of lint cotton.

In terms of gross revenue, cotton is clearly the preferred crop, but the labor intensiveness of cotton production is well known, and, with rising wage rates, perhaps a different set of alternatives would appear. In order to examine this problem, one must consider net rather than gross revenues. Data for this problem are from a recent study by Grady B. Crowe.[2]

Despite an estimated wage rate for common labor somewhat below that inferred from the 1954 Census of Agriculture, I used these data as a starting point. Readers should bear in mind that these estimates exclude a number of overhead expenses.[3] However, these expenses would not be likely to differ materially with respect to the particular crop grown. In interpreting the tabular materials below, readers should not confuse net *operating* revenues with net revenues.

All of the expense data utilized assume modern four-row tractor equipment and, in the case of cotton, cross-plowing production technique. Total specified production costs for land yielding one bale of cotton per acre follow:

Cotton (hand harvest)	$105.06
(machine harvest)	94.59[4]
Soybeans	16.83
Corn	25.40

Net operating revenues for the various crop alternatives on land yielding one bale per acre appear in column 4 of Table 1.

TABLE 1. NET OPERATING REVENUES PER ACRE FOR LAND OF VARYING YIELDS, ASSUMING RECENT RELATIVE COMMODITY PRICES AND A COMMON LABOR WAGE RATE OF $0.35 PER HOUR

Crop	Land quality based upon cotton yields per acre				
	½ bale	¾ bale	1 bale	1¼ bales	1½ bales
Cotton (hand harvest)	$23.12	$55.53	$87.94	$120.35	$152.75
(machine harvest)	16.71	57.56	98.41	139.26	180.11
Soybeans	8.17	20.67	33.17	45.67	58.17
Corn	1.60	15.10	28.60	42.10	55.60

The best alternative for all land grades shown is clearly with cotton. This analysis also shows machine harvesting to yield higher net operating

[2] Grady B. Crowe, *Specified Producion Costs for Cotton and Alternative Crops, Yazoo-Mississippi Delta* (Stoneville, Mississippi: 1956).

[3] Principal excluded expenditures or charges are those for land, hired management, building repairs and depreciation, taxes, insurance, drainage, transportation, and interest for working capital loans. Fixed and operating costs for machinery, including cotton harvesting machines, are included.

[4] Assumes the use of modern ginning equipment with lint cleaners. Costs of loss in cotton grade and of cotton wasted inherent in machine harvesting subtracted.

revenues than hand harvesting except on the poorest land. In this and all subsequent tables, all expenses specified by Crowe are regarded as fixed regardless of yield, except cotton harvesting expenses, including labor, ginning and bagging costs, and losses in grade and wasted cotton associated with machine harvest. Because of the large amounts of labor used in hand harvesting, costs of cotton harvesting vary more with yield under hand harvesting than under machine harvesting.

Effect of Increased Wage Rates

Table 2 gives effect to a doubling of wage rates: for common labor

TABLE 2. NET OPERATING REVENUES PER ACRE FOR LAND OF VARYING YIELDS, ASSUMING RECENT RELATIVE COMMODITY PRICES AND A COMMON LABOR WAGE RATE OF $0.70 PER HOUR

Crop	Land quality based upon cotton yields per acre				
	½ bale	¾ bale	1 bale	1¼ bales	1½ bales
Cotton (hand harvest)	−$12.36	$ 7.50	$27.36	$ 47.22	$ 67.07
(machine harvest)	2.64	42.62	82.60	122.58	162.56
Soybeans	4.79	17.29	29.79	42.29	54.79
Corn	−3.41	10.09	23.59	37.09	50.59

from $0.35 to $0.70 per hour, for skilled labor from $0.65 to $1.30 per hour. Although these rates are higher than current wages in the area, they are entirely reasonable future possibilities. There is some question also whether common and skilled labor would increase at the same rates. There is, of course, no necessary reason for them to do so, although judging from comparison with a 1949 study it is likely that skilled wages will tend to rise more rapidly than will wages of common labor.[5] These two studies,[6] made six years apart, recognize no increase in the common wage rate; but they show a $0.15 per hour increase (30 per cent) in skilled wage rates over six years. These changes in estimated wage rates by degree of skill may provide an explanation of the out-migration pattern from the area's agriculture. A migration study[7] found that agriculturally advanced counties, in the farm income per worker sense, within this area tended to have highest rates of out-migration. Because these counties tend to be more highly mechanized, this may in part reflect greater mobility of

[5] Grady B. Crowe and Jesse P. Gaines, *Preliminary Estimates of Specified Production Costs for Cotton and Alternative Crops, Yazoo-Mississippi Delta* (State College, Mississippi: 1949).

[6] *Ibid.*, and Crowe, *op. cit.*

[7] Frank T. Bachmura, "Migration and Factor Adjustment in Lower Mississippi Valley Agriculture: 1940-50," *Journal of Farm Economics*, Vol. XXXVIII, No. 4 (Nov. 1956), pp. 1024-1042.

skilled workers *vis a vis* unskilled, resulting in a leftward shift of the supply schedule which in turn would reflect greater pressure on skilled than on unskilled wages.

Larger relative increases in wage rates of skilled labor would lessen the advantages of machine over hand harvesting to some degree and thus would be expected to retard mechanization of cotton harvesting. However, the considerable cost advantage of machine harvesting would not be outweighed even with relatively high wages for skilled labor under most circumstances considered.

Since Table 2 is identical with Table 1 except for the effect of increased wages, it is clear that generally increasing wage rates increase the advantage of machine harvesting over hand harvesting and that on the lowest grades of land, soybeans become a preferred alternative to cotton. This cost advantage pattern continues even with a tripling of wage rates to $1.10 per hour for common labor and to $1.95 for skilled. Actually our assumption of proportional variation of soybean yields with those for cotton is likely to understate actual soybean yields on land yielding less than one bale of cotton per acre, since land less adaptable for cotton in this area is often well adapted to soybeans. Therefore, all tables shown understate relative financial attractiveness of soybean cultivation on

TABLE 8. NET OPERATING REVENUES PER ACRE FOR LAND OF VARYING YIELDS, ASSUMING RECENT RELATIVE COMMODITY PRICES AND COMMON LABOR WAGE RATE OF $1.05 PER HOUR

Crop	Land quality based on cotton yields per acre				
	½ bale	¾ bale	1 bale	1¼ bales	1½ bales
Cotton (hand harvest)	−$47.84	−$40.53	−$33.22	−$ 25.91	−$ 18.61
(machine harvest)	−9.84	30.07	69.98	109.89	149.79
Soybeans	1.41	13.91	26.41	38.91	51.41
Corn	−8.72	5.08	18.58	32.08	45.58

lower grade cotton land, and presumably overstate it on higher grade cotton land.

Prevalence of Low-yielding Cotton Land in the "Delta"

The question next arises, "Is it not unrealistic to assume that land of so low a cotton yield as ½ bale per acre is prevalent in "delta" areas? The answer is "No." County average cotton yields per acre for 13 of 16 delta counties computed from the last seven U. S. censuses of agriculture reveal that only in exceptional counties in exceptional years were average yields as high as one bale per acre recorded. Acreage allotments naturally caused a selective elimination of lowest-yielding land with a consequent

increase in average yields in a number of census years. In the light of these facts, the low coefficient of variation for annual cotton yields in this area,[8] and the existence of land yielding 1½ bales per acre, it is reasonable, although, of course, not necessary, to assume a distribution of land quality within the "delta" in which yields of ½ bale per acre are not uncommon. The question then becomes, "Would this land remain in cotton under the aforementioned assumption?" The answer is "No" if one assumes increasing wage rates and a $0.33 cotton price. The interesting result of these computations is that the next higher yielding land (¾ bale per acre) retains its attractiveness for cotton even wih sharply rising wages. Although rising wage rates will force some land out of cotton even without acreage allotments, cotton will very likely continue to predominate in the agricultural economy of this area.

The Effects of Technological Change

There are numerous possibilities for changing the technological conditions of the area's agriculture. As these pertain to cotton they may be classified as yield-increasing, including higher-yielding seed, superior fertilizers and insecticides, and supplemental irrigation, or as expense-decreasing. The latter would include new labor-saving methods of controlling weeds, the development of a cotton plant more suitable for machine harvesting, *e.g.*, with leaves that will be less likely to discolor or to adhere to lint, and changes in cotton harvesting machinery. Of these possible developments, supplemental irrigation is well advanced into a period of innovation and produces dramatic results.

Recent years of less than average rainfall have focused upon the possibilities of supplemental irrigation in "delta" agriculture as well as in many areas in the otherwise humid climate area of the south. Because of the seasonality of rainfall in the area, with dry weather in the late summer and early fall, ripe cotton is likely to be undamaged by rainfall and corn is likely to be unable to develop sufficiently to assure good yields.[9] Thus, some have thought that corn yields would tend to rise more than cotton yields with the use of supplemental irrigation,[10] and so possibly permit a corn-livestock type of agricultural organization.

A recent study provides empirical data for testing these possibilities.[11]

[8] John L. Fulmer and Ralph R. Botts, *Analysis of Factors Influencing Cotton Yields and their Variability* (Washington: U.S. Department of Agriculture, 1951), Technical Bulletin No. 1042, pp. 156-169.

[9] E. L. Langsford and B. H. Thibodeaux, *Plantation Organization and Operation in the Yazoo-Mississippi Delta Area* (Washington: U.S. Department of Agriculture, 1939), Technical Bulletin No. 682, pp. 9-15.

[10] Perrin Grissom, W. A. Raney, and Peter Hogg, *Crop Response to Irrigation in the Yazoo-Mississippi Delta* (State College, Mississippi: Agricultural Experiment, 1955).

[11] *Ibid.*

The history of crop response to irrigation is rather short and there is a great deal of variation indicated, depending on the year considered, on the number of irrigation applications, the amount of fertilizer used, and so on. It is clear, however, that supplemental irrigation increases physical yields of corn more than those of either cotton or soybeans. Estimated average increases attributable to this use of supplemental irrigation derived from the aforementioned study follow: cotton, 25 per cent; soybeans, 25 per cent; corn, 35 per cent. Table 4 gives effect to these changes in yield. These admittedly tentative estimates assume conditions identical with those in Table 1 except that I subtracted additional harvesting costs attributable to increased cotton yields and irrigation costs. The later I estimated to be $11.25 per acre for corn and soybeans and $22.50 per acre for cotton.[12]

TABLE 4. NET OPERATING REVENUES PER ACRE FOR LAND OF VARYING YIELDS, ASSUMING RECENT RELATIVE COMMODITY PRICES, SUPPLEMENTAL IRRIGATION, AND A COMMON LABOR WAGE RATE OF $0.35 PER HOUR

Crop	Land quality based upon unirrigated cotton yields per acre				
	½ bale	¾ bale	1 bale	1¼ bales	1½ bales
Cotton (hand harvest)	$16.83	$57.34	$ 97.85	$138.36	$178.87
(machine harvest)	14.64	65.70	116.76	167.82	218.89
Soybeans	3.17	18.80	34.42	50.05	65.67
Corn	0.20	18.03	36.25	54.48	72.70

Readers should note, however, that net operating incomes on the poorest land are lower with irrigation than without. This is especially true for the poorest land grade shown as well as for corn and soybeans.

Supplemental irrigation, then, apparently would be rational only on a higher quality land and generally favors cotton rather than soybeans or corn. Its effect is to reinforce cotton specialization within the area, except where soybeans would be preferable even without supplemental irrigation. In no case does supplemental irrigation make corn a preferred crop.

Irrigation data available for Arkansas Economic Area 8a indicate a considerable increase in irrigation from 1950 to 1955, but with only a small proportion of acreage so irrigated.[13] Increases in supplemental irrigation will doubtless continue within this area, although innovation may well follow a sporadic pattern influenced by the incidence of dry

[12] I derived these estimates of irrigation from crude estimates made by agricultural economists working in the field. In the absence of precise knowledge of such costs there may be some question with respect to the absolute levels of these irrigation costs. It is not unlikely that they understate the relative cost of irrigating cotton, which requires more applications per season. An addition of, say, $5 per acre of cotton would not affect the preferred combination, however.

[13] *United States Census: Agriculture, 1955*, County Table 1a.

TABLE 5. NET OPERATING REVENUES PER ACRE FOR LAND OF VARYING YIELDS, ASSUMING RECENT RELATIVE COMMODITY PRICES, SUPPLEMENTAL IRRIGATION, AND A COMMON LABOR WAGE RATE OF $1.05 PER HOUR

Crop	Land quality based upon unirrigated cotton yields per acre				
	½ bale	¾ bale	1 bale	1¼ bales	1½ bales
Cotton (hand harvest)	−$66.68	−$57.54	−$48.41	−$ 39.28	−$ 30.14
(machine harvest)	−10.75	39.94	90.64	141.33	192.04
Soybeans	−3.59	12.04	27.66	43.29	58.91
Corn	−10.21	8.02	26.24	44.47	62.69

years. Entrepreneurs should examine cost-revenue relationships closely as they apply to lower-yielding land. Moreover, the long-run effect of increasing wages will have a direct bearing upon the wisdom of long-term investment in irrigation equipment on intermediate grade land since while such investment may pay off with existing wage rates, increased wages could change the investment to a losing proposition.

Because of the relatively short history of supplemental irrigation data in this area, the percentage increases in yield must be taken as tentative. Particularly with respect to corn there are a few specialized instances in which supplemental irrigation combined with fertilizer applications produced phenomenal increases in yield.[14]

Table 6 gives effect to a relative decrease in the price of cotton to $0.28 per pound (a highly tentative approximation of world price in the absence of CCC acquisitions) without any change in prices of cottonseed,

TABLE 6. NET OPERATING REVENUES PER ACRE FOR LAND OF VARYING YIELDS, ASSUMING RECENT COMMODITY PRICES FOR COTTONSEED, CORN, AND SOYBEANS, A PRICE OF $0.28 PER POUND FOR COTTON, NO IRRIGATION, AND A COMMON LABOR WAGE RATE OF $0.35 PER HOUR

Crop	Land quality based upon unirrigated cotton yields per acre				
	½ bale	¾ bale	1 bale	1¼ bales	1½ bales
Cotton (hand harvest)	$10.62	$36.78	$62.94	$ 89.50	$115.25
(machine harvest)	4.21	38.81	73.41	109.01	142.61
Soybeans	8.17	20.67	33.17	45.67	58.17
Corn	1.60	15.10	28.60	42.10	55.60

corn or soybeans. A relative price decline of this amount gives an advantage to hand-picked cotton the same as found under the recent rela-

[14] Grissom, Raney, and Hogg, *op. cit.*, pp. 19-21. If increased yields for corn are set at 70 rather than 35 per cent, corn would not displace the preferred crop in any table shown herein. In some instances corn would yield greater net operating revenues than soybeans, but these are instances in which cotton is the preferred crop.

tive price situation shown in Table 1 (column 2). This would not be true of land yielding ¾ bale per acre. These statements assume no irrigation and a common wage rate of $0.35 per hour. With the addition of supplemental irrigation, net operating revenues for all situations on ½ bale per acre land would be less than without irrigation, as with recent relative commodity prices.

The use of supplemental irrigation given these wages would not alter the preferred crop on any grade land. However, irrigation would diminish, rather than augment, net operating revenues on lowest-yielding land.

TABLE 7. NET OPERATING REVENUES PER ACRE FOR LAND OF VARYING YIELDS, ASSUMING RECENT COMMODITY PRICES FOR CORN AND SOYBEANS AND A PRICE OF $0.28 PER POUND FOR COTTON, SUPPLEMENTAL IRRIGATION, AND A COMMON LABOR WAGE RATE OF $1.05 PER HOUR

Crop	Land quality based upon unirrigated cotton yields per acre				
	½ bale	¾ bale	1 bale	1¼ bales	1½ bales
Cotton (hand harvest)	−$82.31	−$80.98	−$79.66	−$ 78.34	−$ 77.02
(machine harvest)	−26.38	16.50	58.39	102.27	145.16
Soybeans	−3.59	12.04	27.66	43.29	58.91
Corn	−10.21	8.02	26.24	44.47	62.69

Table 7 takes the most extreme set of assumptions into account, that is, low cotton price, tripled wages with supplemental irrigation.

As can be seen, these extreme assumptions affect cotton's relative attractiveness only in one grade of land, namely ½ bale per acre.

Prognosis

Wage rates within the Arkansas-Mississippi "delta," which reflect the large-scale out-migration of agricultural labor, are likely to continue to rise. Current hourly farm wage rates in the area approximate 50 cents per hour. Census reports indicate for the two census years 1950 and 1955 an increase of hourly wage rates ranging between 17 to 20 per cent in a five-year period. Extrapolation of this trend still would not bring about a 70 cent per hour wage rate within ten years, and a $1.05 per hour wage rate would be correspondingly farther off. Because of drought in 1954, cotton yields and, correspondingly, the demand for common labor was relatively low. In addition, the 1950-55 period was one of rapid mechanization which had the effect of reducing the demand for common labor. The rise of wage rates in the face of this decreased demand undoubtedly means further wage increases over time. These will become very important in years of good harvest and in those with no acreage restrictions. With the establishment of relatives and friends in urban communities

outside the "delta" areas, it is very likely that out-migration of actual and potential members of the agricultural labor force will continue so long as high levels of employment are maintained in urban centers. This, of course, by the reduction of labor supply in the area, will tend to raise wage rates.

The effect of the wage rate increases will be to stimulate mechanization of cotton harvesting still further, and will encourage the use of supplemental irrigation within the area. The effect of declining prices of cotton would be to stimulate mechanization and irrigation as well.

The transfer of land out of cotton may be expected to proceed slowly, being stimulated by the rise of wage rates and the decline of cotton prices, and being retarded by further mechanization and irrigation of cotton production. However, with or without acreage allotments, the prudent course is to make substitutions for cotton on the lowest-yielding land first.

Without acreage allotments, undoubtedly cotton acreage would increase in the "delta" areas at this time. Even with $0.33 cotton, however, it is unlikely that as much "delta" land would be put into cotton as in 1949, the last census production year prior to the reinstitution of acreage controls. This pattern reflects a trend away from cotton production even under essentially competitive conditions. Largely, I think, this can be attributed to the rising wages rate stemming from out-migration.

One of the major limitations of this study is that it does not consider more than three crops and eliminates consideration of livestock possibilities, *i.e.*, the possibilities of pasture development, of a corn-hog type of agriculture, or the possibilities of rice production[15]—alternatives requiring major changes in the investment pattern. Examination of these possibilities might discover a production function intermediate in the degree of labor use between mechanized cotton production and the production of soybeans. This does not imply, of course, an all-or-nothing solution—a cotton-soybeans agriculture may well become the dominant type within the next fifteen or twenty years, even without the acreage allotments for cotton that have occasioned major shifts to soybean acreage in recent years.

[15] In recent years, rice production has expanded in Economic Area 8a in Arkansas.

AGRICULTURAL HOME PRICES AND INCOME STABILIZATION

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THE widespread concern of primary-producing countries with economic stability, their susceptibility to changes beyond their control, and their development of various techniques to cope with these instabilities are all well known. Stabilization measures affecting their exports, all suffer from serious limitations: dual pricing; resource misallocation; administrative and procedural problems; income de-stabilization because of quantum changes.

In mid-1948, the Secretary General of the United Nations inquired of its membership what measures they contemplated which entailed "national and international action to achieve and maintain full employment and economic stability and concerning publicly available plans to prevent a decline in employment and economic stability."[1] Australia, not untypical of the replies of other governments, said that "The present economic policy of the Government has three main aspects: the control of the upward surge of inflation now so as to moderate the extent of any decline later; the introduction where practicable of 'automatic' stabilizers into the economic system; and the intensification of preparations to meet a possible decline in demand."[2] Specifically the statement referred to "arrangements for the maintenance of local prices on a higher level than export prices in times when these are low."[3]

In this note, I shall focus on the so-called "home-price" technique used in Australia with butter, sultanas, other dried fruits, wheat, flour and rationalized on the highly dubious grounds that the exporting country that cannot stabilize its producers' incomes by affecting the world prices of its exports can affect them and the balance of the economy by maintaining the prices of those export commodities in the home market above world prices.[4] The technique was conceived in 1926 when the Patterson

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[1] United Nations Secretariat. Department of Economic Affairs. *Maintenance of Full Employment*, Lake Success, New York, 1949, p. 1.

[2] *Ibid.*, p. 70.

[3] *Ibid.*, p. 72.

[4] Controls have gone beyond the degree implied by the home-price technique under the 5-year stabilization plan that came into operation in 1952 and under which the Commonwealth Government with the approval of the individual states determines each season the ex-factory prices of butter and cheese, guarantees to dairy farmers a return based on costs of efficient production in respect of quantities of butter and cheese sold within the Commonwealth plus an additional 20 per cent if produced. It hence determines the amount of subsidy it will make available to lift the return on that part of output covered by the guarantee level.

Amounts realized on exports of butter and cheese in excess of f.o.b. equivalent

Plan for butter was adopted; its use was broadened during the depression of the 1930's.

The maintenance of the home price of a product above its world price necessitates the fulfillment of several conditions. To forestall the entrance into the domestic market of competing imports that would destroy the effectiveness of the home plan a tariff or some other direct import limitation is needed. This practice was followed in 1934 at a time when the home price of butter in the latter country was 6.7d. per pound higher than the net export price (the world market price less transportation and other changes incurred in shipping the commodity from the domestic market) and when butter imported from New Zealand could be landed in Australia, duty free, at less than 1d. higher than that net export price. A tariff levied against imported butter was necessary so that the home price would not be rendered ineffective. A similar procedure was invoked with flour under the Wheat Assistance Act of 1938.

Some effective organization to fix and maintain the home price must exist. Under the Patterson Plan, voluntary producers' pools were established and when these began to break down in the early thirties, they were made compulsory.[5] These pools are marketing organizations and constitute effective cartels that operate under the label of "orderly marketing," but in reality are vehicles for raising home prices and for increasing incomes of primary producers. Under the Wheat Industry Assistance Act of 1938, the home price of flour was fixed by legislation.

Under the Wheat Act of 1938, the price of wheat utilized for human consumption was set at 5s. 2d.; it is uncertain how this price was set, although the average export price that year was 5s. 2¾d. The peak price was 5s. 9d. per bushel. In addition, each state legislature fixed the price of flour at between £A11 and £A13 10s. per ton, of bread at not more than 6d. per two-pound loaf. Millers buying their wheat in the open market paid net export prices. If these were under the fixed home consumption price, they were required to pay on flour domestically consumed an excise tax sufficient to raise the effective cost per bushel of wheat used in that flour to 5/2. If, on the other hand, the price paid by the millers and received by the wheat growers for wheat going into domestically-consumed flour exceeded 5s. 2d., a tax would be imposed on all wheat produced. The tax per bushel would be governed by the proportion of

of the guaranteed return have been credited to the Dairy Stabilization Fund established January 1, 1948 for purpose of stabilizing returns from exports. During 1951-52, the Stabilization Fund met deficiency in respect of all exports that did not return sufficient to meet the basic return to the factory.

[5] Since 1934 when the compulsory price stabilization plan was invalidated, the price scheme for butter has operated on a voluntary basis and has involved agreements between butter producers and a Dairy Produce Equalization Committee.

the total wheat crop used domestically for human consumption and the difference between the export parity price and the established price of 5/2.[6]

The artificial raising of the lower price for butter was achieved through the combined utilization of excise taxes on production and the payment of export bounties with the proceeds. The higher yield on butter exports equal to the current net export price plus a bounty varying from 3d. to 4½d. per pound causes, in effect, a reallocation of butter from the home market to the export market; the home price is thereby forced to increase until it exceeds the export price by the amount of the bounty per pound.[7]

The export bounty of, say, 3d. per pound will cause an increase in the home price, but whether or not a redistribution of income in favor of producers will occur will depend on the price elasticity of domestic demand for the export commodity and on the proportion of that product consumed domestically. The plan would be totally ineffective only if the domestic demand for the export product were perfectly elastic. In this instance, the excise levy that would just equal the bounty payments on exports, will lead to higher production costs and the burden or incidence of the levy would weigh on the producers *in toto*. But with a price elasticity of domestic demand greater than unity, the enhanced receipts of the butter producers attributable to the export bounty could be offset in the home market, either partially or completely, depending on the proportion consumed domestically—the greater the proportion consumed domestically, the greater the offset. However, since the "home price" method has been employed with food items only, the demand elasticity for which is certainly less than one, the average returns would be increased and some redistribution of income would occur from consumers to producers. The effect on total income in the economy would then depend on the marginal propensities to spend of the broad groups affected.

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[6] The tax amount per bushel of wheat would bear the same proportion to the excess of the export parity price over 5/2 as the quantity of wheat consumed in Australia for human purposes during the period beginning October 1 of each year plus 12 months bore to the total wheat harvested during the same period. The amount of the tax, x, would be computed as follows:

$$\frac{x}{\text{export parity price}-5/2} = \frac{\text{no. of bushels of wheat home consumed}}{\text{total wheat crop}}$$

[7] If the domestic demand for butter were perfectly inelastic and if we assume that 450 million pounds of butter were produced and sold, a 3d. bounty on exports would result in an increase in total receipts of £A5,625,000, part of which would originate with the change in domestic prices following the export bounty and part of which would originate from a levy of 1.6 d. per bushel over total production in order to yield the 3d. bounty on exports, or a total levy of £A3,062,500. The net gain to butter producers under these conditions, since the higher costs associated with the excise tax could not be shifted by them, would amount to £A2,562,500.

Some observations and conclusions of Professor Metzler[8] regarding the redistributive effects of a subsidy to one group financed by a tax imposed on another group would seem to apply to this home price plan. He avers that a "redistribution of income in favor of those with high propensities to consume will always result in an increase in the incomes as a whole," that this "net increase may follow increases in the incomes of the high-propensity group which exceed the decline in the incomes of both groups. The taxed group does not gain from a redistribution unless the marginal propensity to consume of the subsidized group (the affected primary producers) exceeds unity. In the case referred to above (fn. 7), the following presentation depicts some possible cases:

	(millions of £A)		
	Home Consumers	Home Producers	Net Change
Net proceeds redistributed	−2.5625	+2.5625	—
Case I:			
Marginal propensity to consume	.80	.70	
Redistribution Multiplier			−.4
Net income change			−1.0250
Case II:			
Marginal propensity to consume	.70	.80	
Redistribution Multiplier			+.4
Net income change			1.0250
Case III:			
Marginal propensity to consume	.60	1.10	
Redistribution Multiplier			+.46⅔
Net income change			1.1705

Professor Metzler goes on to point out that the

"Redistribution Multiplier[9] is equal to the product of (1) the investment multiplier and (2) the difference between the marginal propensity to consume of the subsidized class and the marginal propensity to consume of the taxed class [for] a given redistribution of incomes between two groups to increase total incomes more than a corresponding amount of net investment [would require that the] marginal propensity to consume of the high propensity group be more than unity. This appears highly improbable since it requires a marginal propensity to consume for the subsidized class considerably greater than unity. Additions to net investment, therefore, will usually provide a greater

[8] Lloyd A. Metzler, "Effects of Income Redistribution," *Review of Economics & Statistics*, XXV (1943), pp. 49-57.

[9] The "redistribution multiplier" is the multiplier effect arising by reason of a redistribution of income in favor of those with high propensties to consume. Professor Metzler sets up several hypothetical cases entailing income transfers between taxed and subsidized groups, on the one hand, and taxed, subsidized and intermediate groups on the other side; he makes alternative assumptions as to the marginal propensity to consume of each group, examines the distribution effects of the income re-distribution on each group separately and in total. (*Ibid.*, pp. 53, 54, 55.) The general applications of this type of analysis are obviously numerous.

stimulus than redistribution in favor of those with high propensities to consume.[10]

It is likewise improbable that these requirements would be fulfilled in Australia. The positive income effects of investment will not likely be felt by the primary producers, both because of the low income-elasticity of domestic demand for primary products and because such a small part of the major primary products are consumed in Australia. Domestic investment measures would have to be supplemented by means that directly affected the incomes of primary producers.

In order to maintain or to raise average returns of producers when export prices fall under the home-price technique, it would be necessary for these home prices to be continually augmented and for there to be a continuous redistribution of incomes; these effects would be conditioned by the distribution of the product between the export and the home markets. The average return per unit of product would be unaffected if the income decline were caused by a lower physical volume of exports.

The financing of bounty payments could be accomplished more effectively through borrowing from the central bank, or from funds derived from general revenues. While the effect of the method adopted on the incomes of primary producers would be conditioned by the bounty per unit paid, by the domestic demand elasticity and the proportion of the product consumed domestically, the payment of a bounty on *all* production would not entail a redistribution of income;[11] it would entail a minimum net addition to the spending capacity of the economy equal to the total bounty paid. The effects of either method on the balance of payments could be mitigated by drawing on exchange reserves. Additional stimuli following the payment of a bounty on all production would be provided to the economy (1) because of increased cash balances, if funds were to come from the central bank, or (2) because of a higher velocity of money, if surpluses were drawn upon. Such a bounty would be inadequate, if the deflation stemmed from a decline in physical production and exports. Crop insurance or buffer-stock operations would then be preferred. In sum, then, the positive income effects associated with this "home price" technique will depend on the price elasticity of domestic demand for the export commodity, the proportions of the primary product going into domestic and export markets, the marginal propensities to spend of the affected economic groups, the method of financing the bounty payments and the changes in the volume of exports.

In Australia, too, the maintenance of these home prices overstates the

[10] *Ibid.*, p. 56.

[11] There would, of course, be some redistribution if the bounty were financed from general taxation.

living-cost index and money wages—which quarterly are adjusted to changes in that index by the Australian Arbitration Board—and production costs. These effects would negate the income gains associated with the bounty payments.

The effects on balance of payments will depend on the income and cost and price effects of the higher home prices of exports. The effects on income will be a function of the price elasticity of domestic demand for exports, of the size of the bounty payment, and of the very method of financing the bounty payment that is employed. The effects on production will depend on the domestic demand elasticity and on the magnitude of the excise levy imposed for purposes of paying the bounty. (If the excise tax method were not used, the production effects would be related to changes in income and would operate only from the demand side. Therefore there ought not be any significant cost effects.)

The payment of export bounties on differentiated products will reduce export prices, improve their world competitive position. Balance of payments and income effects would depend on the demand elasticities of foreign buyers for these products and on the shifts in countries' demands for them that occurred. Bounties for antideflationary purposes accompanied by higher import tariffs are similar to an exchange depreciation and could be beggar-thy-neighbor in their effects. There are, however, significant differences between the bounty-tariff combination and exchange rate manipulations. Variations in exchange rates affect all imports and exports and are associated more with a generalized balance-of-payments condition. No distinction is made between exports requiring and those not requiring assistance; no distinction is made between imports with domestic substitutes and those not having such substitutes. The balance of payments effects depend on the combined effects of demand elasticity for imports and exports and on the income effects flowing from the improved income position of the exporters. Account must be taken of the important time element in that elasticities are greater over the long run. Also, the effects on production costs, following higher import and export prices, will lead over the longer run to a reduction in the balance-of-payments advantages deriving from the depreciation.

Although the bounty-tariff combination can be used selectively, its effect on those exports and imports affected will, in a more limited sense, be identical to those of an exchange depreciation. With either measure, world prices of differentiated products would be reduced but whether or not foreign currency receipts would increase would be contingent on the nature of the market and, hence, the foreign demand elasticity. With an exchange depreciation, the burden of an external debt would be increased; but there would be no such problem with the bounty-tariff

combination. With an exchange depreciation, some redistribution of income in the economy will occur as export and import prices relative to other prices; but the increases in exporters' incomes will originate from causes operating largely outside the economy. This will depend on the foreign demand elasticity and on the degree of depreciation. This is not so in the bounty case unless it leads to a reduction in the export price of the commodity. The magnitude of the bounty and foreign demand elasticity then becomes relevant.

The preference of one method—exchange depreciation or bounty-tariff combination—over the other depends on whether or not general or more selective methods are adequate for the given problem. In any case, it is self-evident that any measure that distorts the price structure will distort the efficient allocation of resources. The Rural Reconstruction Commission of Australia, recognizing this regarding its dairying industry, has stated that "the artificial support of exports at favorable prices has the effect of maintaining the industry in unsuitable areas and the ineffective farmers on their farms; . . . this is bound to injure the national dividend because competition left to itself will continually push resources from points of low productivity to points of higher productivity, thus tending always from less favorable and towards more favorable arrangements of the community's resources."

ECONOMIC ASPECTS OF MOTOR TRANSPORTATION IN MARKETING LIVESTOCK

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AN IMPORTANT function of marketing livestock is the physical movement of the live animals from the farm to the market and/or to the packing plant. As livestock, in the present time, has to be transported either by railroad or by motor truck, shippers have to choose between these two alternative methods of transportation. Also, as there is no general rule to be relied upon for determining which method could be used to the greater advantage, shippers have to make a decision as to the mode of transport suitable to each set of circumstances the individual shipper is likely to encounter, i.e., the species of animal, the number of animals shipped, the particular destinations, the type of market (terminal vs. auction), etc.

In order to reach profitable decisions, shippers have to make their comparison between railroads and trucks on the same basis. In comparing costs, for example, it is important to begin at the farm and to consider all items of expense until the shipment is delivered at the point at which the shipper ceases to be financially concerned with the process of getting the livestock to the receiver. Such costs include the actual money outlay for the transportation service and expenses en route, together with losses from death, crippling, bruising, and tissue shrinkage of animals. In addition, "service" factors, which are not directly measurable in terms of money, such as convenience, should be taken into account. Such factors are largely a matter of individual judgment, and there cannot be any rule for how much they mean to different individuals.

Livestock producers, especially the small producers, may find difficulty in reaching good decisions as to which method of transportation is better. They often need guidance in evaluating the various factors involved. Such guidance could be provided by farmers' organizations and experiment stations. In addition, farmers and shippers can benefit from the experience of their neighbors in the livestock industry by knowing the reasons behind the diversion of livestock traffic from rail to truck or vice versa and the advantages that have attracted shippers to use motor trucks instead of railroads.

Diversion of Traffic from Rail to Truck

Many livestock producers and shippers have shifted from hauling their animals by rail to hauling them by truck. The reasons behind such diver-

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sion could be either the "rate" factors, or the "service" factors, or both. In the following discussion we will try to show which of these factors is mainly responsible for such diversion.

"Rate" factors: Such factors include all costs and charges for the transportation service. This could be directly measured in terms of money such as:

1. Transportation rates. Some studies have been made to measure the difference between truck and rail rates for hauling livestock. For example, in 1941, a study by the Ohio Agricultural Experiment Station found that the average rate from 16 towns to Cleveland was 0.175 (dollars per hundred weight) by rail and 0.3098 by truck for cattle; and 0.1987 by rail and 0.31111 by truck for hogs.[1]

Table I shows a comparison between rail and truck rates on load shipments of livestock to Portland, Oregon. From this table, it is clear that motor truck rates are higher than rail rates in most cases.

TABLE I

From	*Rail*	*Truck*
The Dalles, Oregon	32	36
Pendleton, Oregon	46	56
Klamach Falls, Oregon	58	70
Baker, Oregon	59	65
Enterprise, Oregon	60	73
Ontario, Oregon	67	76
Redmond, Oregon	51	51
Princeville, Oregon	51	51
La Grande, Oregon	56	56

Source: W. H. Dreesen, *Transportation Rates on Livestock and Meat Products in Western States,* Oregon Ag. Exp. Sta., Bul. No. 496, March, 1951, p. 11.

In July, 1956, rail and truck rates on load shipments of hogs from Champaign-Urbana, Illinois to Chicago, Indianapolis, and East St. Louis were as follows:

	Rates in Cents per Hundredweight[2]	
To	*Rail*	*Truck*
Chicago, Illinois	42	40
Indianapois, Indiana	39	40
East St. Louis, Illinois	45	55

This shows that truck rates were lower than rail rates only to Chicago, but higher to Indianapolis and East St. Louis.

[1] G. F. Henning and E. B. Poling, *Motor Transportation of Livestock,* Ohio Agr. Exp. Sta., Bul. No. 625, Dec., 1941, p. 35.

[2] Information gathered by the writer from railroad and truck companies in the area.

2. Transit insurance. In marketing livestock, losses arise from the death and/or crippling of animals in transit. This risk can be covered by commercial insurance.

A study by R. C. Ashby showed that transit insurance rates applying to motor trucks are approximately double those applying to railroads for the same distance.[3] This difference is largely due to two factors: (1) losses in truck consignments have been much greater than losses in rail shipments, and (2) the insurance company recovers a considerable part of its losses on rail shipments from the railroad companies. However, it must be remembered that the rates applying to railroads do not cover losses occurring while transporting from the farm to the railroad shipping point. Even if we add the insurance charges for the distance between the farm and the railroad shipping point, still the insurance charges on railroad shipments will be lower than those on truck shipments.

3. Shrinkage. Shrinkage in transit has reference to the loss in the animal weight between the original point (farm) and the destination. It may result from excretions or from loss in tissue weight. Both kinds of shrinkage are intimately associated with the physiological functioning of the animal body.

The increase in shrinkage as time in transit increases applies both to tissue and excretory shrinkage. The greatest proportion of the loss in weight during the early part of the transit period is due to excretory shrinkage. Tissue shrinkage, on the other hand, tends to continue throughout the period in transit. Therefore, reduced time in transit results in reduced shrinkage. Present conditions—improved highways and motor equipment, higher speed of trucks, the fact that trucks are not required to follow definite routes, definite schedules or to make station stops that usually need to be made by railroads—have made it possible to haul the animals from the point of origin to their destination, whether a market or a packing plant, in less time by motor truck than by rail. Therefore, in the absence of definite information, it is fairly reasonable to say that the shrinkage on motor truck shipments is as low or lower than shrinkage on rail shipments.

4. Feeding. Animals are usually fed and watered in transit if it takes a longer time from the farm to the market or the packing house than the animals can bear. The railroad companies usually make a separate charge for the feeding and watering of animals in transit.

As trucks usually take considerably less time in transit than railroads, there is a possibility that the animals will not need to be fed in transit

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[3] R. C. Ashby, *Essentials of Marketing Livestock*, Morningside College, 1953, p. 68.

when shipped by truck, while they may be fed at least once when shipped by railroad.

"Service" factors: Such factors include all advantages not directly measurable in terms of expense such as:

1. Convenience. Livestock trucking makes its strongest appeal to the livestock producers and shippers because of its convenience and because of the greater flexibility of movement permitted. Since the value to be placed on convenience is largely a matter of individual judgment, it cannot be readily measured in dollars. One may total all factors that are measurable in dollars, however, and then set off the net difference against convenience.

A livestock producer may use his own truck or he may call a commercial trucker and his animals will be transported direct from the feedlot on his farm to the market or the packing plant. In the case of rail shipments, it is necessary to order the cars in advance, haul or drive the livestock to the railroad, bed and load the cars, and consign the shipment to the designated market. Consequently, less time and effort are required on the part of the farmer when he ships by for-hire motor trucks than when the animals are hauled by railroads.

Also, if a livestock producer can fill a truck, there is no delay in waiting for neighbors to obtain sufficient livestock to load a carload as is often true in cooperative rail shipments. Even the larger feeder who ordinarily can market a carload himself, finds that all animals do not finish at the same time and it is economical to market a motor truck load at the time when the animals are ready for sale.

2. Choice of markets. Motor truck transportation is more elastic and flexible than rail transportation, because motor trucks do not need to follow fixed routes or move according to definite schedules. The motor truck has enabled livestock producers and dealers to exercise more freedom as to the time and place of marketing. The radio and telephone have brought producers and dealers in closer touch with the various markets, so they can take advantage of the particular market that offers the best price for a given class and grade of livestock. Many producers are so located that they can wait for the opening quotations at a market in the area before deciding whether they should ship on that particular day or withhold a shipment hoping to obtain a more favorable price later on.

The ability of motor trucks to move in any desired direction has resulted in an increase in the number of outlets available for marketing livestock. Railroads follow definite established routes and trains move on prearranged schedules. If it is necessary to move over two or more lines in order to reach a certain desired market, delays and layovers often occur.

3. Effect on marketing methods. The motor truck transportation has helped in developing and accelerating certain marketing systems that the livestock producers liked the best, i.e., direct marketing,[4] a term that refers to the sale and transfer of livestock from one party to another without passing through the terminal public market or making use of the services of agencies located at them.

Therefore, from the above-mentioned analysis of the "rate" and "service" factors, it is fairly reasonable to conclude that the "service" factors have been the most important and the strongest appealing reasons for diversion of livestock traffic from rail to truck. Convenience and adaptability of the motor truck have been attracting livestock shippers more than savings in nominal charges of transportation. This conclusion has been also supported by the answers on a questionnaire sent by the writer to the cooperative livestck marketing associations all over the country. In answering the question, "Why Do You Use Trucks?" only two associations—Chicago Producers Commission Association, Illinois, and Evansville Producers Commission Association, Indiana—were using them because of lower trucking charges and "service" factors; while the remaining 36 associations mentioned only the "service" factors, namely, convenience, speed, and flexibility.

In addition, it can be said that it is doubtful that railroads may regain livestock traffic from motor trucks in the future, because of the following:

1. Railroads cannot provide the "service" factors that made trucks more acceptable and preferable.

2. If motor transportation charges do not greatly increase relatively to railroad charges, railroads may have to decrease their rates considerably in order to offset the "service" advantages of motor trucks. However, rail rates are not decreasing but increasing.[5] On the other hand, in the case of truck transportation there are actions taking place to reduce the livestock trucking costs or losses especially by reducing the losses of death and crippling in transit.

Even if we assume that railroads will decrease their rates considerably to offset the advantages of trucks, it is also doubtful that there will be any shift of traffic to railroads—at least in the short run. Many shippers and receivers have adjusted their operations to handle motor truck shipments. Also, the direct marketing system has been accepted by farmers,

[4] Aly A. Abdou, *The Relationship between Motor Transportation and Marketing of Agricultural Products*, Doctorate Dissertation in Business, University of Illinois, Urbana, 1956.

[5] The ICC approved an increase of 5 per cent on railroad rates for livestock . . . effective March 7, 1956. This new increase is the 12th actual rise in railroad freight rates granted by the ICC during the last ten years . . . United States Department of Agriculture, *Marketing Activities*, May, 1956, pp. 1-2.

and the local markets usually get their supply from the nearby areas where it is rather convenient to use motor trucks.

Although the proportion of livestock traffic still handled by railroads is hauled relatively long distances, motor trucks have been also competing for such business. If anything could be said about the future, it can be said that motor trucks will gain more traffic at the expense of railroads and not the other way around.

Reduction of Transportation Rates

The livestock trucking bill could be reduced either by lowering the motor truck rates through competition with rail, or through competition among truckers, which could be enhanced by reducing the real cost of motor transportation incurred by trucking firms.

Competition between trucks and railroads cannot be counted upon to accomplish any major reduction in transportation charges. Truck operators might reduce their rates if railroad operators reduced their rates to an extent that could offset the "service" advantages of trucks, from the shippers' standpoint. But as rail rates have been increasing during the last decade, there was no pressure upon truckers from railroads to reduce their rates. Also, trucks may gain more livestock traffic at the expense of railroads, as has happened before, without reducing their rates as far as the difference in rates does not offset the "service" advantages of trucks.

Reducing the transportation bill by improving the efficiency of trucking practices appears to offer greater promise than a reduction in rates through competition with railroads. Some of such savings in reduction of trucking costs will be passed to shippers—in lower rates—by competition among truckers. Adoption of practices, such as the following, seems to offer the best hope for reducing costs: Use the appropriate size and type of truck and fit the truck to the task. In assembling livestock locally, every effort should be made to avoid special trips for single animals or small lots. Whenever possible, trucks should be routed with the aim of picking up capacity loads with a minimum of travel. This may require limiting service in a certain area to a specified day or days, depending upon the volume available. Capacity loads should be hauled from farms, local markets, or local assembly points to distant packing plants or other markets. Whenever practicable, avoid overlapping and cross-hauling, either by truckers in the same area, or by truckers from nearby communities. Obtain return loads whenever this is practicable.

The adoption of such plans to insure greater efficiency in using motor trucks engaged in hauling livestock is not simple, however, as a great deal of cooperation between truckers and livestock producers is required.

The existence of many individual farm patrons and many independent truckers has led to several inefficient practices. For example, farmers have become accustomed to calling truckers by telephone and asking them to come over to their farms to pick up maybe one cow, veal calf, or a few hogs. Usually the farmer expects prompt service, either because he thinks that market prices at such time are favorable, or because weather or other conditions make it desirable that his animals be moved promptly. In most cases, the independent trucker responds rather quickly to the call of the livestock producer, even though such trips sometimes involve considerable mileage to pick up one or a few animals. The trucker fears that if he does not render prompt service, the customer may turn to another trucker now or in the future. In many cases truckers feel obliged to make many trips on which returns do not even cover operating expense in order to create or maintain goodwill among livestock producers. Such customary practices undoubtedly add to the cost of marketing the nation's livestock.

There are methods of applying the above-mentioned practices and bringing about greater efficiency in the use of livestock trucks. For example, livestock producers could agree to give a notice to the trucker of their choice, at least 48 hours in advance of the time their animals have to be hauled. The longer the period allowed, the greater is the opportunity for truckers to arrange for capacity loads. This could be done informally; or truckers may organize a formal association to deal with farmers. The main disadvantages of this method are: First, it will deprive the producer of the advantage of moving his stock directly to the market of higher price once he knows about it from the radio or by telephone. Second, at best, it would eliminate a part, and probably a small part, of the inefficiency in trucking practices.

Another possible method is for truckers in a certain area to adopt uniform minimum charges for local hauling that would tend to discourage special trips to pick up or deliver one or a few animals. If such minimum charges vary with distance regardless of the number or weight of animals to be moved at a single stop, livestock producers may be discouraged from calling for individual trip services unless they have loads at capacity or near capacity. This plan may be more effective than the preceding one, because of the financial inducement for livestock producers to avoid separate trips for small shipments. Although it would not eliminate all overlapping trips by truckers in a certain area or all cross-hauling between truckers in nearby areas, it may reduce both. Its main weaknesses are: First, it would not solve the whole problem. Second, it will make little appeal to farmers unless at least some of the savings are passed on to them in lower truck charges. Third, the cooperation of all livestock truckers, including local dealers who haul for themselves, for

hire, or both, does not seem to be practicable at all times. Fourth, this method may lessen competition and may lead to over-all agreement on rates.

Another possible method would be for farmers in certain areas to organize cooperative marketing associations that would handle both the transporting and merchandising of their livestock. So, beside using the transportation facilities as effectively as possible, the manager of the association will have to secure daily market information in order to take advantage of the differences in prices in different outlets and to obtain the highest possible net returns for the members of the association. It is not likely that efficient transportation, of and by itself, would insure the success of such association, although it would contribute to this end. The association can either operate its own trucks or hire private trucks. This depends upon the transportation facilities, rates, and the density of livestock in the area.

By requiring members of the association to notify the manager of their animals well in advance of marketing, it will be possible to reduce greatly the number of trips in which the load is less than capacity. As long as the management is working effectively on the marketing practices, and as long as members are sure that they obtain the highest possible returns for their livestock through the association, they will not hesitate to cooperate or notify the manager of their animals early enough before the time they are to be moved. Overlapping and crosshauling will be largely eliminated. This method will have the merit of being organized and operated by and for farmers. In short, it will have many advantages over any of the other methods mentioned, and few of the weaknesses.

Reduction of In-transit Losses

Insurance rates could be reduced by lessening in-transit losses of deads and cripples. This could be enhanced by emphasis on the following practices: Use suitable loading chutes. No clubs or canes should be used for moving animals. Furnish trucks with adequate and suitable bedding and remove all sharp objects. Do not overload or underload. Different species should be separated by suitable partitions. Overfeeding before loading should be avoided, and animals should be protected, as possible, from bad weather. Truckers should drive carefully and make frequent stops en route to market to inspect their shipments.

Reduction of Trade Barriers

Various states have different truck weights and size limits, licensing regulations, taxes and so forth. Such differences often cause costly re-routing or reloading. Increased uniformity of regulations could reduce transportation costs.

A NOTE ON THE TRANSCENDENTAL PRODUCTION FUNCTION

$$y = cx_1^{a_1}e^{b_1x_1}x_2^{a_2}e^{b_2x_2}$$

A. N. Halter, H. O. Carter, and J. G. Hocking*

THIS note provides a description and an illustrative example of a transcendental production function that may prove useful to agricultural economists and others in the field of production economics. We do not attempt to add to the theory concerning the "true input-output relationships" that exist between variables in the various production processes. Instead, we present a function that is consistent with classical textbook production functions. This function can exhibit nonconstant elasticity,[1] i.e., increasing, decreasing, and negative marginal returns, singularly, in pairs, or all three simultaneously.

The general form of the function under consideration is

$$y = cx_1^{a_1}e^{b_1x_1}x_2^{a_2}e^{b_2x_2} \cdots x_n^{a_n}e^{b_nx_n}, \tag{1}$$

in which y is the total output (dependent variable), $x_1, x_2, \cdots, x_n$ are the quantities of inputs (independent variables), e is the base of natural logarithms and c, $a_1, \cdots, a_n$, $b_1, \cdots, b_n$ are parameters. This paper first discusses the mathematical properties of the function. Second, economic principles are illustrated using this function as a production function.

Mathematical Properties

The properties of the single variable production function

$$y = cx^ae^{bx} \tag{2}$$

are examined first. Then the more general case of two inputs is discussed. The difficulties involved in dealing with a greater number of inputs is merely notational, not conceptual. All logarithms are to the base e.

The properties of (2) which are of interest as a production function are those for non-negative inputs and may be derived explicitly with the aid of the first and second derivatives. The first derivative of (2) is

$$\frac{dy}{dx} = y\left(\frac{a}{x} + b\right) \tag{3}$$

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[1] The definition of the elasticity of production is given by the equation

$$E = \frac{dy}{dx_i} \cdot \frac{x_i}{y}$$

By setting the first derivative equal to zero and solving for x, the input which yields maximum output is obtained as

$$x = -\frac{a}{b} \tag{4}$$

The second derivative is

$$\frac{d^2y}{dx^2} = y\left(\frac{a^2 - a}{x^2} + \frac{2ab}{x} + b^2\right) \tag{5}$$

Setting (5) equal to zero and solving for x, the input corresponding to the point of inflection is obtained as

$$x = \frac{-a + \sqrt{a}}{b} \tag{6}$$

(Note that only non-negative values of the input x are of interest here.)

The properties of interest are summarized in Table 1.

TABLE 1. PROPERTIES OF $y = cx^a e^{bx}$

Value of b	Value of a	$y = cx^a e^{bx}$
$b<0$	$0<a\leqq 1$	increases at a decreasing rate until $x=-\frac{a}{b}$, then decreases
	$a>1$	increases at an increasing rate until $x=\frac{-a+\sqrt{a}}{b}$, then increases at a decreasing rate until $x=-\frac{a}{b}$, then decreases
$b=0$*	$0<a<1$	increases at a decreasing rate
	$a=1$	increases at a constant rate
	$0>1$	increases at an increasing rate
$b>0$	$0<a<1$	increases at a decreasing rate until $x=\frac{-a+\sqrt{a}}{b}$, then increases at an increasing rate
	$a\geqq 1$	increases at an increasing rate

* With $b=0$, this function is the Cobb-Douglas production function.

As Table 1 shows, the most interesting cases of this function occur when the value of b is negative and a is greater than one. Then equations (4) and (6) are satisfied by positive values of the input x and the classical textbook production function is obtained. That is, the output y first increases at an

TABLE 2. CRITICAL VALUES OF x_1 AND x_2 FOR $y=cx_1^{a_1}e^{b_1x_1}x_2^{a_2}e^{b_2x_2}$

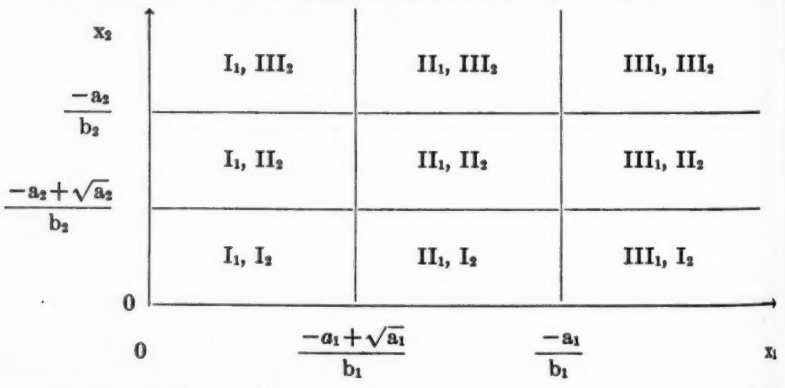
Variable input	Increasing output y		Decreasing output y
	Increasing rate	Decreasing	
x_1 (x_2 fixed)	$0 \leqq x_1 < \frac{-a_1+\sqrt{a_1}}{b_1}$	$\frac{-a_1+\sqrt{a_1}}{b_1} < x_1 < -\frac{a_1}{b_1}$	$x_1 > -\frac{a_1}{b_1}$
x_2 (x_1 fixed)	$0 \leqq x_2 < \frac{-a_2+\sqrt{a_2}}{b_2}$	$\frac{-a_2+\sqrt{a_2}}{b_2} < x_2 < -\frac{a_2}{b_2}$	$x_2 > -\frac{a_2}{b_2}$

increasing rate, then at a decreasing rate. After reaching a maximum, the output decreases as the law of diminishing returns requires. Another interesting feature is that this function becomes the Cobb-Douglas production function ($y=cx^a$) when $b=0$ and is therefore a true generalization of that well known function.

The two variable input case is considered next. Letting, say, x_1 and x_2 vary while $x_3, x_4, \cdots, x_n$ are held constant yields a function which may be pictured as a geometric surface in three dimensions. Using partial derivatives just as the ordinary derivatives were used above, the critical values of input x_1 (holding input x_2 constant) and of x_2 (holding x_1 constant) may be determined. With values of b_1 and b_2 both negative while a_1 and a_2 are taken as greater than one (the interesting cases again), the critical values of inputs and the behavior of the output are shown in Table 2.

Table 3 below shows the various combinations of the rates of change of

TABLE 3. COMBINATIONS OF RATES OF CHANGE OF $y=cx_1^{a_1}e^{b_1x_1}x_2^{a_2}e^{b_2x_2}$*



* I_i means y increasing at an increasing rate for x_i, i=1, 2
II_i means y increasing at a decreasing rate for x_i, i=1, 2
III_i means y decreasing for x_i, i=1, 2

output y that are possible over the surface[2] with this function. The Roman numerals indicate the nine combinations of rates of change that are possible in the two-input case.

The important iso-lines on the surface, i.e. the maximum iso-lines[3] and the inflection iso-lines are vertical and horizontal lines (when projected on the plane of x_1x_2). This fact implies that x_1 and x_2 are independent factors in the production of y and indicates one of the limitations of this function.

Clearly the maximum output y occurs at the intersection of the two maximum iso-lines, i.e., at the point where

$$x_1 = -\frac{a_1}{b_1}, \qquad x_2 = -\frac{a_2}{b_2}$$

Illustrating Economic Principles

The first derivative is a mathematical concept of particular importance to production economics. In the two-input case, the marginal physical products of the inputs are represented by the first partial derivatives of the production function. Thus, for the function under discussion, these are

$$\frac{y}{x_i} = y\left(\frac{a_i}{x_i} + b_i\right), \qquad i = 1, 2. \tag{7}$$

The iso-product contours or iso-quants are obtained by setting y equal to a constant. This yields an implicit function of x_1 and x_2 that may be solved for either imput in terms of the other. For the function under consideration, the iso-quants have the equation

$$\log x_1 + mx_1 = u \log x_2 + vx_2 + k, \tag{8}$$

where

$$m = \frac{b_1}{a_1}$$

$$u = -\frac{a_2}{a_1}$$

$$v = -\frac{b_2}{a_1}$$

$$k = \frac{1}{a_1}(\log y - \log c)$$

---

[2] The y dimension is projected onto the plane of x_1x_2 for purposes of illustration.

[3] The locus of all points (x_1, x_2), where x_2 is fixed, at which the output is a maximum and similarly for (x_1, x_2) with x_1 fixed.

The marginal rates of substitution along any contour line can be derived from the definition

$$\underset{1,2}{\text{MRS}} = \frac{dx_1}{dx_2} = \frac{\dfrac{y}{x_2}}{\dfrac{y}{x_1}}$$

This ratio of partial derivatives in the present case is

$$\underset{1,2}{\text{MRS}} = \frac{x_1}{x_2} \cdot \frac{a_2 + b_2x_2}{a_1 + b_1x_1} \tag{9}$$

Setting (9) equal to the price ratio $-P_{x_2}/P_{x_1} = \alpha$ and solving for x_2 in terms of x_1 yields the expansion line,[4] i.e., the line of least-cost combinations or optimum proportions, as follows:

$$x_2 = \frac{a_2x_1}{x_1(\alpha b_1 - b_2) + a_1} \tag{10}$$

In the event that $Px_1x_1 + Px_2x_2 = L$, where L is a constant, the optimum point on the expansion line can be derived by solving the following quadratic equation:

$$Px_1Ax_1^2 - Bx_1 + C = 0 \tag{11}$$

where

$$A = \frac{Px_1}{Px_2} b_2 - b_1$$

$$B = Px_1(a_1 + a_2) + LA,$$

and

$$C = La_1.$$

The optimum point on the expansion line assuming conditions of perfect competition can be obtained to a desired degree of accuracy by such an iterative method as the Newton-Raphson successive approximations.[5]

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[4] In the single-output case the optimum input level is obtained by equating the marginal physical product to the price ratio γ of input. In the present case

$$x = \frac{ay}{\gamma - by}$$

[5] Any elementary calculus textbook explains Newton's method.

Example

The function $y = cx_1^{a_1}e^{b_1x_1}x_2^{a_2}e^{b_2x_2}$ was fitted to some conjectured data, shown in Table 4, in order to illustrate the properties that have been discussed. There were two reasons for using conjectured data. The first reason was to have a symmetric set of data and the second was to provide teachers of production economics with a most useful set of data for constructing classroom problems. One of the authors has used this set of data to illustrate the types of errors that can be made by applying unrealistic equations to describe production relationships.[6]

TABLE 4. HYPOTHETICAL DATA USED IN FITTING THE EQUATION $y = cx_1^{a_1}e^{b_1x_1}x_2^{a_2}e^{b_2x_2}$

	1	2	3	4	5	6
1	.2	.5	5	6	2.5	3
	.5*	.2	5	4	3	2
	.8	3.5	5	2	3.5	1
2	1	22	29	35	28	20
	2	20	30	35	25	20
	3	18	31	35	22	20
3	7	33	47	62	56	37
	5	30	45	60	55	40
	3	27	43	58	54	43
4	5	30	65	67	66	58
	4	35	60	65	63	55
	3	40	55	63	60	52
5	5	26	56	66	78	69
	3	25	55	63	75	65
	1	24	54	60	72	61
6	2	18	41	60	70	60
	2	20	40	55	65	60
	2	22	39	50	60	60

* The second number in each cell is the mean of the two "observations." These means were not used in fitting the equation.

Converting the function to logarithmic form yields

$$\log y = \log c + a_1 \log x_1 + b_1x_1 + a_2 \log x_2 + b_2x_2 \tag{12}$$

Equation (12) was fitted by the method of least squares[7] and gave the following predicting function:

$$y = 1.95x_1^{3.78}(0.4)^{x_1}x_2^{4.09}(0.4)^{x_2} \tag{13}$$

[6] It should be pointed out that these conjectured data are not intended to be used in making statistical inferences. The authors are preparing a second article in which the production function presented here will be fitted to experimental data. This equation has forced the development of some special statistical procedures, e.g. the standard error of the M.V.P. estimates takes on a special form.

[7] The method of least squares applied to the logarithmic form does not necessarily give exactly the same parameter values as when applied to the original function.

(We have written $e^{a_1 b_1}$ as $(e^{a_1})^{x_1} = c_1^{x_1}$ for convenience.)

The characteristics of the function (13) are summarized in Table 2. Thus, with x_2 held constant, y increases at an increasing rate until

$$x_1 = \frac{-a_1 + \sqrt{a_1}}{b_1} = 2,$$

then increases at a decreasing rate until

$$x_1 = -\frac{a_1}{b_1} = 4.125,$$

at which point y is a maximum, and thereafter y decreases. An analogous situation holds for the input x_2 when x_1 is held fixed.

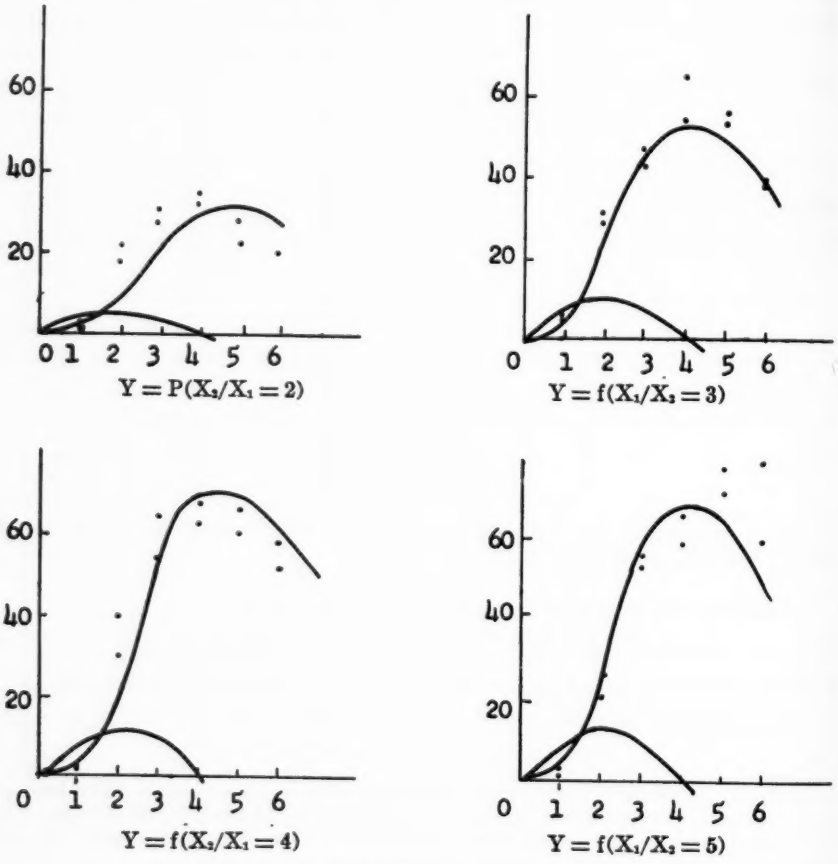

FIG. 1. Vertical sections through the surface
$Y = 1.95X_1^{3.78 \cdot 4^{x_1}} X_2^{4.09 \cdot 4^{x_2}}$

To illustrate this production function as a geometric surface in three dimensions, several vertical sections through the surface are shown in Figure 1.

The marginal physical product curve can be derived from equation (5); and if another scale is superimposed on the y-axis to stand for the first derivative, the marginal physical product curves in relation to the total physical product curve can be shown. These marginal physical product curves are also shown in the diagrams in Figure 1. These curves are at a maximum at the point of inflection on the total physical product curves and are equal to zero when the total physical product is at zero and at a maximum.

A number of horizontal sections through the surface at y levels equal to 10, 30, 50, and 70 illustrate the nature of the closed contour curves and are shown in Figure 2. The equation of these contours given by (6) with the appropriate substitution of the estimated parameters is as follows:

$$\log x_1 - .2424x_2 = .9242 \log x_2 - .2424x_2 + .1766 - \frac{\log v}{3.78} \tag{14}$$

Newton's iterative method is a practical means of solving this equation in most instances. If the equation $y = f(x_1, x_2)$ is plotted, as in Figure 1, initial approximations are readily available.

The equation of the expansion line is given by (9). As an illustration we

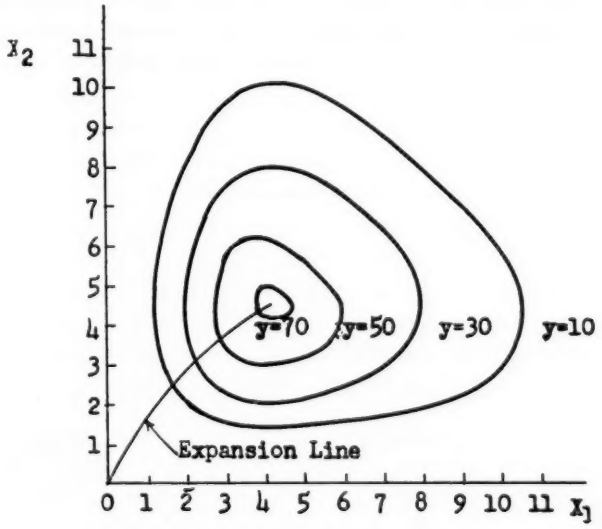

FIG. 2. Horizontal sections through the surface
$Y = 1.95X_1^{3.78}.4^{x_1}X_2^{4.09}.4^{x_2}$

may let the price ratio equal one half. Then the equation of the expansion line for (13) becomes:

$$\frac{4.09x_1}{.4581x_1+1.89} \tag{15}$$

and is shown in Figure 2.

Again for illustrative purposes, assume that Py equals .10. Then the optimum point on the expansion line was found by successive approximations. In this instance, the optimum combination of inputs x_1 and x_2 are 3 and 3.7 respectively and the output y is 52.25. An initial approximation to x_1 can be made by plotting the expansion line in the yx_1-plane and finding a point where a line of slope Px_1/Py is tangent to the curve. The expansion line in the yx_1-plane can be plotted after substituting in the predicting function the value of x_2 obtained by solving (14).

Conclusions

The function described and illustrated by the foregoing appears to be useful in describing data that show the three traditional phases of the marginal product curve, i.e., increasing, positive and negative decreasing. Although this note has examined only the two-variable input case, similar procedures could be followed in extending it to more than two inputs. The calculations involved in finding an economic optimum seem extensive. When such information is required, however, the problems could be easily programmed for an automatic calculating machine. When a flexible predicting function is desired to fit data and a numerical function is needed to teach production economic principles, this discussion should prove helpful.

SOLUTION OF ASSIGNMENT PROBLEMS BY DIRECTED GRAPHS

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A NUMBER of linear programming problems of importance to agriculture belong to the general class called assignment problems: i.e., those in which specified requirements (in different uses, at different locations, etc.) are to be optimally satisfied by the assignment of amounts of a homogeneous resource available for the purpose (from different processes, at different locations etc.) The transportation problems, in which deficiencies at specified locations are to be satisfied by the shipment of surpluses from specified locations in such fashion as to minimize transportation cost, is a prototype of the assignment problem.

Several methods for the solution of such problems have been discussed.[1] In this paper a new procedure will be illustrated in which the directed graph is used as the central tool. Although the direct application of this method is limited to relatively small problems,[2] as a pedagogical device the graph is without equal. The graph provides the student with a concrete expression of the problem, and gives insight into the steps of the solution entirely lacking in abstract algebraic methods. In the following presentation the pedagogical aspects of the method will be emphasized.

A directed graph is defined as any collection of points, some of which are connected by directed lines which we may, for simplicity, call "arrows." Each of the figures of Figure 1 is a directed graph. A consists of four points with arrows pointing out from point (1) to each of the others; the three points of B are connected by two arrows emanating from point (3), the other going from (1) to (2). Although four of the five points of C are connected by arrows, the fifth point is isolated.

In general any number of points and any pattern of interconnecting arrows is permissible in a graph. Moreover the only thing that matters is the identification of the points and the arrows. The physical representation, e.g. the selection of lengths and shapes for the arrows, the layout of the graph on the page, etc., may be selected to suit convenience. For example, Graph D of Figure 1 is the same as Graph A.

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[1] See, for example, Milton M. Snodgrass and Charles E. French, "Simplified Presentation of "Transportation-Problem Procedure' in Linear Programming," *Journal of Farm Economics*, Vol. 39, No. 1, January, 1957, pp. 40-51, and the literature there cited.

[2] A problem involving N locations will require N(N-1) entries in Table I. (See below.) Although half of these are simply copied with a change in sign, the burden of computation still increases approximately as the square of the number of locations.

The study of graphs and their properties involves an extensive mathematics.[3] For the present purpose, however, it is only necessary to distinguish two properties of graphs. A graph is called *connected* when, for every pair of points in the graph, it is always possible to find a path of arrows leading from one to the other. It is *not* required that this path coincide with the directions of the arrows over which it passes, nor does it matter how many intermediate points are passed through on the trip. If we think of the arrows simply as members that connect the points together, a connected graph is any one that can be picked up in a single piece. In Figure 1, graphs A, B, and D are connected; graph C is not.

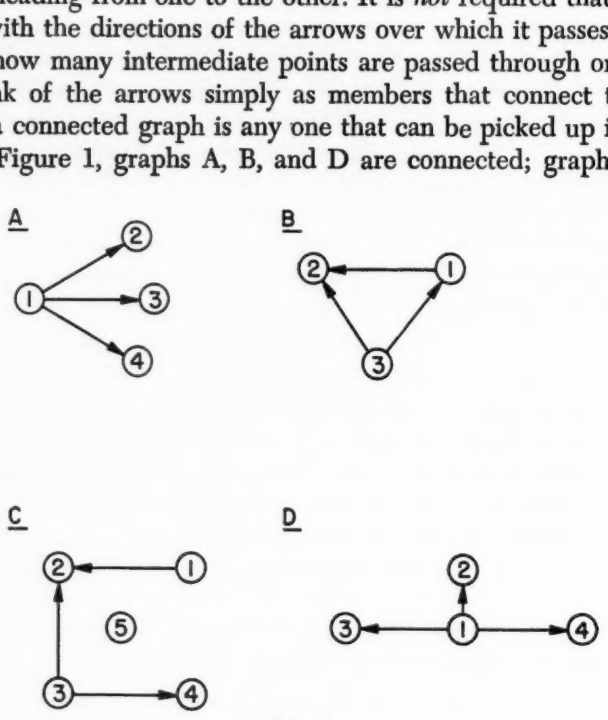

FIG. 1

A graph is *cyclical*, or contains a cycle, whenever there exists a closed path of arrows permitting a round trip which can be followed without passing over the same arrow twice. B is a cyclical graph; the others of Figure 1 are not. Note that the cycle need not follow all arrows in the same direction.

The great advantage of using the graph is precisely that it can be represented by points and lines on paper. Discussion in the text, however, and any algebraic manipulation require an alternative notation. For this purpose we will denote a point by enclosing its number in parentheses: e.g. (4). An arrow will be represented by A_{ij}, the first subscript designat-

[3] An excellent introduction to graph theory with particular emphasis on applications in social sciences will be found in Frank Harary and Robert Z. Norman, *Graph Theory as a Model in Social Science* (Research Center for Group Dynamics Monograph No. 2), Institute for Social Research, University of Michigan, Ann Arbor, 1953.

ing the origin of the arrow, the second the point at which the tip rests: A_{52} is the arrow extending from (5) to (2). Finally, it is convenient to refer to the direction of a given path over an arrow. If the direction of a path coincides with the direction of the arrow, the arrow is said to be traversed in a positive direction. The arrow is traversed negatively when the direction of the path is opposed to the direction of the arrow.

The nature of the transportation problem is generally known and we need make only a few remarks about it. We are given a set of output (export, surplus, or source) points, each endowed with a specified amount of homogeneous output; also a set of input (import, deficit, or disposition) points, each with a specified requirement of the homogeneous commodity as input. We are also given a list of possible point-to-point shipping paths and the unit cost of shipping along each. We are required to assign quantities of goods to the available shipping paths in such fashion (a) that the requirements of the input points are satisfied and (b) that the total shipping cost is a minimum.

To facilitate comparison of the graphical method with other techniques we will illustrate the procedure with the same example used by Snodgrass and French. Their data for the problem are as follows:[4]

Point	*Available Output*	*Required Input*
(1)	–	20
(2)	–	10
(3)	5	–
(4)	25	–

Unit Shipping Costs

From/To	(1)	(2)	(3)	(4)
(1)	–	2	4	6
(2)	2	–	6	2
(3)	4	6	–	4
(4)	6	2	4	–

The first step in the graphical procedure is to set up a format such as Table I to receive calculations. In column (1) we list all available assignments (routes) and in column (2) record the cost of each route as given in the shipping-cost table. The remaining columns will be ignored for the moment. We obtain our first basis or tentative solution as follows: on a sheet of paper set down the output points on the left and the input points on the right, noting the quantities available or required at each point. The order in which the points in each set are placed is immaterial. We now construct a graph on these points by connecting an arrow from the top output point to the top input point. (See Figure 2.) This arrow

[4] Snodgrass & French, *loc. cit.*, p. 42. The shipping cost matrix used happens to be symmetrical. In general this need not be so, and the symmetry plays no role in the solution.

TABLE 1

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Route	Direct unit cost	Basis 1		Basis 2		Basis 3	
		Equiv. cost	Net saving	Equiv. cost	Net saving	Equiv. cost	Net saving
A 12	2	−4	—	−4	—	−2	—
A 13	4	−10	—	−4	—	−4	—
A 14	6	−6	—	−6	—	−4	—
A 21	2	4	2	4	2	2	0
A 23	6	−6	—	0	—	−2	—
A 24	2	−2	—	−2	—	−2	—
A 31	4	10	6	4	0	4	0
A 32	6	6	0	0	—	2	−4
A 34	4	4	0	−2	—	0	—
A 41	6	6	0	6	0	4	−2
A 42	2	2	0	2	0	2	0
A 43	4	−4	—	2	−2	0	—

represents the use of this output point to supply the input requirements of the top input point. If there is more than enough output for this purpose, connected the top output point to the next input point, and continue making connections until the top output is exhausted. The amount

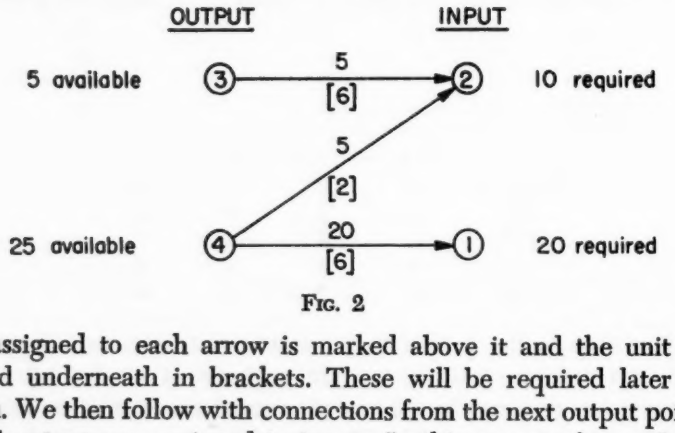

FIG. 2

being assigned to each arrow is marked above it and the unit cost is recorded underneath in brackets. These will be required later in the solution. We then follow with connections from the next output point etc., until all outputs are assigned to inputs. In this way we form a basis for the solution. That is, we obtain a program that will supply the input as required, although not in general at minimum cost. At this point the program is represented by a directed graph that is (a) connected and (b) without cycles.[5]

[5] The graph will have no cycles because of the nature of its construction. Sometimes, however, the graph is not connected, i.e. some proper subset of the output points will precisely satisfy some proper subset of the input requirements. This is degeneracy. It is avoidable in a number of ways, one of which will be noted in our concluding remarks. We will assume for the present that proper steps have been taken to preclude its occurrence.

Since the amounts shipped and the unit costs have been recorded, the total shipping cost is readily calculated from the graph; $(5 \times 6) + (5 \times 2) + (20 \times 6) = 160$. In order to determine if this cost can be reduced, we now ask whether or not we could gain by utilizing some route not included in the basis. For example, what would happen if we sent a unit over A_{34}? In the first place if a unit is sent over A_{34}, only 4 units could be sent over A_{32}. Therefore an additional unit will have to be sent over A_{42} in order to keep (2) supplied. Another way of expressing this is to say that if the route A_{34} is to be included in the shipping program, for every unit sent over it, we must remove a unit from route A_{32} and "remove a negative unit" (i.e. *add* a unit) to A_{42}.

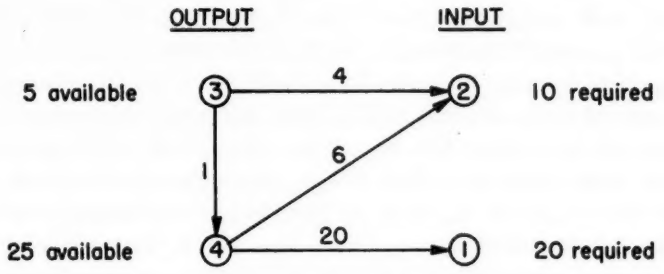

FIG. 2-A

Figure 2-A shows the shipping program modified to include one unit routed over A_{34}. The amount sent over A_{32} has been decreased by one and the amount moving over A_{42} is decreased by minus one. The program still exactly supplies the required inputs from the given outputs. The relationship among A_{34}, A_{32} and A_{42} is expressed as $A_{34} = A_{32} - A_{42}$. This expression means that shipping a unit over A_{34} is the equivalent, so far as accomplishing the program is concerned, of shipping an extra unit via A_{32} and one less unit via A_{42}. $A_{32} - A_{42}$ may be called the basis equivalent of A_{34}.

Whenever required, the unique equivalent of any route A_{ij} may be written down at a glance. We merely follow the path of arrows from (i) to (j), writing down the arrows traversed positively with a plus sign and those traversed negatively with a minus sign.[6] Thus in Figure 2, $A_{21} = -A_{42} + A_{41}$; $A_{13} = -A_{41} + A_{42} - A_{32}$; $A_{24} = -A_{42}$, etc.[7]

[6] That such a path always exists is guaranteed by the fact that the graph is connected. That the path is unique follows from the fact that the graph contains no cycles.

[7] In an expression like $A_{34} = -A_{42}$ we can see most clearly the meaning of equivalence of routes. The expression means that if, in a program already involving shipments from (4) to (2), we include shipments from (2) to (4), every unit moved over the latter route must be sent right back again over the former in order to keep the requirements of (2) supplied.

Understanding the nature of equivalent routes can also be approached in this way: In a connected graph with no cycles, the insertion of a new arrow will always complete one cycle. The equivalent of the inserted arrow is then the remainder of the cyclic path.

Now that an equivalent for each A_{ij} can be found, we may ask if it would pay to insert A_{ij} in the program and remove its equivalent. To determine this we must compare the cost of A_{ij} with the cost of its equivalent. If the former is smaller than the latter, a gain can be had from the substitution. The cost of A_{ij} is already recorded in Table 1. We need only compute and record the cost of its equivalent. It follows from the foregoing that this is readily done by inspection of the graph. We follow the path of arrows from (i) to (j), summing the costs: those associated with arrows traversed positively enter the total positively, those with a negative path enter the total negatively. The result is the unit cost of the basis equivalent and indicates the gross amount that could be saved if the alternate route were followed. The cost of the basis equivalent of A_{34} is thus $6 - 2 = 4$. I.e., 4 per unit is the gross saving associated with route A_{34}. This is not, of course, the *net* unit saving, since the direct cost of A_{34} must be paid before any saving can be realized. The net unit-cost saving from any A_{ij} is the unit cost of the basis equivalent minus the unit cost of A_{ij}. Thus the net saving associated with the introduction into the program of one unit shipped via A_{34} is $4 - 4 = 0$, and there is no net gain to be had from the substitution. When the unit cost of the basis equivalent is negative there is no possibility of positive net saving, since even if the unit cost of A_{ij} were zero, its use would entail an increase in cost.[8]

These costs are quickly computed from the graph, but they need not all be independently calculated. The basis equivalent of A_{ji} is clearly the negative of the basis equivalent of A_{ij}, and if the cost of one has been computed, the other may be immediately set down with merely a sign change. Our next step is to compute column (3) of Table 1 by inspection of the graph, and, where required, obtain column (4) by subtracting the entry in column (2) from the entry in column (3).[9]

Inspection of column (4) indicates that a net saving of 2 per unit would be associated with introducing route A_{21} in the program; a net saving

[8] If we like we can think of any route that enters in a basis equivalent with a negative sign as complementary to the given route. Thus, since $A_{34} = A_{32} - A_{42}$, A_{42} is complementary to A_{34}. Negative costs of basis equivalents are always associated with such complementary routes, arising because an increase in the use of A_{34} requires an increase in the use of A_{42} which, despite the saving from reduction of shipping along A_{32}, may well entail an increase in cost even though the unit cost of A_{34} is small.

[9] Where column (3), the cost of the basis equivalent is a negative number, the net saving will always be negative and no calculation need be made in column (4).

of 6 per unit with the introduction of A_{31} in the program, and that no other substitutions would be profitable. Which substitution should be made? In reaching this decision the experience and judgment of the programmer is of considerable help. In the absence of other criteria a good general policy is to make the substitution with the largest saving in unit cost. Thus we will elect to substitute A_{31} in the program in place of its basis equivalent. Since we gain 6 in net saving for every unit sent over A_{31}, we want to divert as many units as possible to that route. What are the limitations? In order to determine this we inspect the graph and note the basis equivalent of $A_{31} = A_{32} - A_{42} + A_{41}$. This says that diverting a unit to A_{31} permits us to remove a unit from A_{32} and A_{41} provided that we add (remove a negative unit) a unit to A_{42}. We can remove no more units from A_{32} or A_{41} than are already moving over these routes. Inspection of the graph shows that 5 units are moving over A_{32} and 20 units over A_{41}. We can divert 5 units to A_{31}, since we can reduce the traffic on A_{32} by five units, as required. But we clearly cannot reduce the traffic on A_{32} by more than this, and 5 is the maximum number of units we can divert to A_{31}. This gives us our second basis: 5 units shipped over A_{31}, 15 units over A_{41} and 10 units over A_{42}.[10]

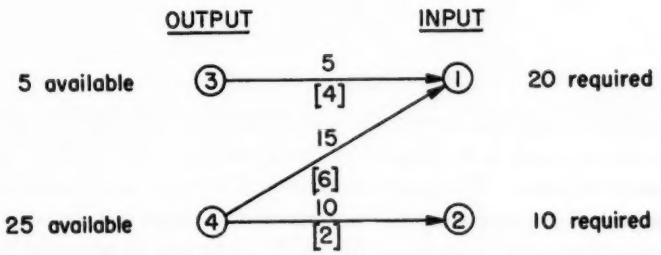

FIG. 3

A new graph (Figure 3) is constructed embodying the new program. Note that we have exercised our privilege of rearranging the points in a more convenient configuration. Computation of the cost of the new program

$$(5 \times 4) + (15 \times 6) + (10 \times 2) = 130$$

[10] The advantage of the graph is that it makes this operation of substitution a common sense procedure. Once this is grasped, the algebraic treatment can be approached with confidence. In the algebra of the graph the substitution is treated as follows: The original program was $5A_{32} + 5A_{42} + 20A_{41}$. In order to save cost we will add θA_{31} to the program and subtract its equivalent $\theta(A_{32} - A_{42} + A_{41})$, so the new program is $\theta A_{31} + (5 - \theta) A_{32} + (5 + \theta) A_{42} + (20 - \theta) A_{41}$. θ is now maximized subject to the condition that no coefficient in the new program be negative. Max. $\theta = 5$ and the new basis becomes $5A_{31} + 10A_{42} + 15 A_{41}$.

verifies that we have made a net saving of 6 per unit for five units diverted to A_{31}. The process of evaluating equivalents is now repeated with the new graph, and the results entered in columns (5) and (6) of Table I. The only profitable substitution is now $A_{21} = -A_{42} + A_{41}$. The graph shows that 15 units of A_{21} can be substituted into the program and the new program becomes $15\ A_{21} + 25\ A_{42} + 5A_{31}$, giving a total net saving of 30. The new program is shown in Figure 4.

The evaluation process is repeated in columns 7 and 8 of Table 1. No profitable substitutions remain, and program 3 is a least-cost program, the total transportation cost having been reduced to 100.

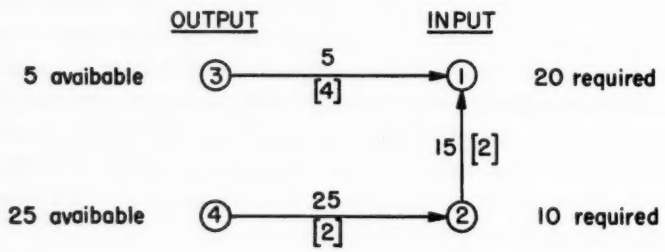

FIG. 4

Concluding Remarks

The graphic technique is merely one method of solving the assignment problem and as such it is subject to the general considerations pertinent to any such solution. We have supposed that total available output is exactly equal to required input. In general this need not be so. If output exceeds requirements, we convert the problem to one of equality by setting up a dummy disposal point with input requirements equal to the excess supply. A unit "shipped" to this point is actually assigned to disposal (storage, dumping, etc.) at the point from which it is shipped. The unit cost of this assignment may be set as appropriate. In order to avoid nonsense solutions, however, no routes out of the disposal point should be permitted.

One interesting by-product of the graphical technique is the illustration of the problem of degeneracy. In terms of the graph, a problem degenerates whenever it is possible to represent a program by a non-connected graph. The problem shown in Figure 5 is degenerate. The effect of degeneracy is seen as soon as we try to determine equivalent costs of certain routes. For example we cannot calculate an equivalent cost for A_{35} or A_{16} or for any route that would connect the graph, since there is no alternative path to follow. The problem of degeneracy can

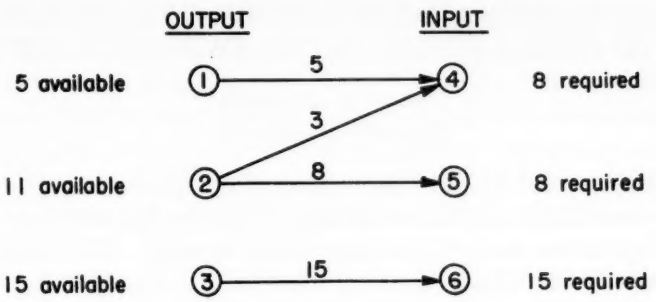

FIG. 5

always be avoided by changing the quantities of the problem very slightly. One way to accomplish this is to divide the last significant digit in the measurement of quantities (outputs and inputs) by 2 m (where m is the number of output points) and add d, the first significant digit in the answer, to the supply of each of the output points and (m × d) to the requirements at an arbitrarily selected input point. The resulting problem always requires a connected graph for its solution.[11] When the optimum solution has been reached in terms of these adjusted quantities, the an-

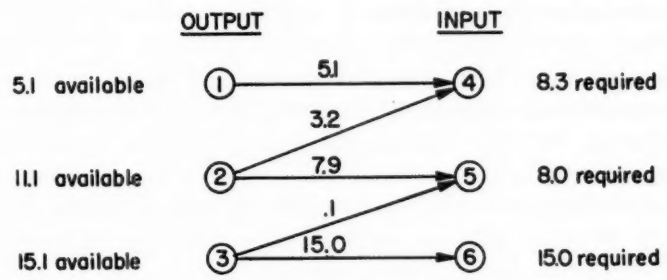

FIG. 6

swers are rounded to the original accuracy and the result is the optimum program for the original problem. This may be applied to Figure 5; m = 3. The last significant digit in the quantities is 1. 1/6 = .16, the first significant digit of which is .1. Hence .1 is added to each supply and .3 to input requirements at, say, (4). The result is a connected graph as shown in Figure 6.

[11] Proof of this proposition is due to A. Orden. See T. C. Koopmans (Editor), *Activity Analysis of Production and Allocation*, New York: John Wiley & Sons, 1951, p. 366, footnote 3

SOCIO-ECONOMIC CHARACTERISTICS OF PART-TIME AND FULL-TIME FARMERS IN THE TWIN-CITIES AREA

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THE downward trend in the percent of population engaged in farming over the years is more striking when the increasing percentage of farm operators working off their farms is taken into consideration. Approximately one fourth of the nation's farm operators engage in such a practice. In some states the trend has been not only to have more of the farm population engaged in off-farm work, but those who work off the farm to do so for longer periods of time.[1]

The extent to which farm operators are dependent on nonfarm sources of income is considered as contributing to increased heterogeneity and instability in the rural social structure.[2] Current sociological analysis holds that the distinctly rural society is characterized by a relatively high degree of homogeneity with respect to social values and behavior patterns, and that the urban or rural-urban fringe is characterized by heterogeneity with respect to occupation, social values, personal behavior and interest groups. The general hypothesis is that variations in social and economic factors contribute to behavior variations along the continuum from one extreme to the other.

The present paper bears upon this general hypothesis in analyzing the socio-economic and attitudinal differences between part-time and full-time operators. Part-time farmers are defined as those working 100 days or more off farm in the calendar year or with income from nonfarm sources exceeding the value of farm products sold. Full-time farmers are those with less than 100 days work off farm and value of farm products sold exceeding that from off-farm sources.

Source of Data

The sample design was basically areal in nature. Initially a purposive selection of census tracts was made so as to exclude from the sample the immediate environs of the City of Minneapolis. The square-mile sections of land in these tracts were numbered to exclude from the sample any incorporated area. Then the selection was made by use of a table of random numbers. In view of the limitation on sample size the procedure

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[1] A. F. Raper, *Rural Trends*, U.S.D.A., Washington, D.C., 1952, p. 8.

[2] Cf. Lowry Nelson, *Rural Sociology*, New York: American Book Company, 1948, pp. 8-11; C. P. Loomis and J. A. Beegle, *Rural Social Systems*, New York: Prentice Hall, Inc., 1950, Appendix A; S. A. Queen and D. B. Carpenter, *The American City*, New York: McGraw Hill Book Co., 1953, pp. 19-27.

of interviewing every part-time farmer in each area and every other full-time farmer was followed, to obtain an approximately equal split between full-time and part-time farmers for comparative purposes. Thus, the universe consideration consists of farmers residing outside of urban or incorporated areas in six purposively selected representative census tracts in Hennepin County, Minnesota.

The data were gathered by the technique of personal interview with 167 farm operators (census definition) during the later part of 1954 and the spring of 1955. The attitude data were gathered by field administration of a modified form of the Rundquist-Sletto Scale which included ten items from each of five of the original scales, only four of which are used in this analysis.[3]

Method of Analysis

The analysis is divided into two parts. In the first part the dependent variables under consideration are marital status, religion, socio-economic

[3] For an analysis of the scale construction and establishment of norms see E. A. Rundquist and R. F. Sletto, *Personality in the Depression*, Minneapolis: University of Minnesota Press, 1936. The scores on the modified form using ten items correlated .89 or higher on all four scales with the total scores on all the items. The items in the Rundquist-Sletto Scales consist of declarative statements with which the individual may indicate whether or not he agrees or disagrees and the intensity with which he agrees or disagrees on a five-point scale. The declarative statements are constructed on the basis of values and patterns considered to be generally accepted institutional patterns. For example, the family scale includes items such as "A man should be willing to sacrifice everything for his family;" "In making plans for the future, parents should be given first consideration." In the law scale are such items as "A man should obey the law no matter how much they interfere with his personal ambitions;" "Laws are so often made for the benefit of small selfish groups that a man cannot respect the law." In the education scale such items as "A man can learn more by working four years than by going to high school;" "An educated man can advance more rapidly in business and industry" are included. In the economic conservatism scale such items as "The government should take over all large-scale industry;" "Private ownership of property is necessary for economic progress" are included. In these scales values were assigned to the responses in such a way that a low total score indicated favorable attitudes toward existing family patterns, respect for existing law practices, economic conservatism and a high regard for the value of education. The items were arranged in random order.

Thus, when one refers to a favorable attitude towards law it indicates that the individual has respect for existing practices in the area of law, and an unfavorable attitude would be indicative of a desire to see changes in the basic value orientation of our legal institutions. The favorable attitude toward the economic institution would be one that reflects a general agreement on the part of the respondent with the values of a laissez faire model such as lack of government intervention, private property, profit maximation and individual initiative. A favorable attitude toward the family institution would indicate a desire to maintain a strong family bond with primary obedience and obligation to the parents. The favorable attitude towards education would be one that supported a value of compulsory public education and viewed education as both an end in itself and as a valuable aid to social and economic adjustment. Unfavorable attitudes in all cases would be ones that reflect the desire for social change in the basic institutional patterns of our culture.

status (Sewell Scale),[4] farm organization membership, family size, visiting pattern, father's occupation, church attendance, income, size of farm.

The second part consists of an analysis of the factors associated with attitude scores of operators of a modified version of the Rundquist-Sletto Scale in the areas of family, law, education, and economic conservatism. The major independent variable is the type-of-farming operation. This is measured by the extent of off-farm work engaged in by the operator. The criterion of 100-or-more days of off-farm work segregated full from part-time farmers.[5]

In analyzing the results of the attitude scales the independent variables used were (1) religion, (2) education, (3) age, (4) socio-economic status, (5) political affiliation, (6) union membership (for part-time farmers only, and (7) farm organization membership.

The Chi-square technique was used to test significance of differences and where the values were significant to the .05 level, corrected contingency coefficients were computed. Both total and partial association techniques were used in the analysis of attitude scales.

Findings

Social differences. The part-time and full-time operators did not differ significantly on the following factors: (1) religious preference, (2) citizenship, (3) nationality, (4) church attendance and (5) motion picture attendance. Both groups were largely German-Catholics and German-Lutherans with church attendance averaging three times a month. Motion

[4] This scale contains 14 items relating to material possessions, cultural possessions, and social participation and has been found to be a valid and reliable indicator of socio-economic status among farm families in several states. The scale includes such items as type of house construction, presence or absence of lighting facilities, piped water, refrigeration, radio, telephone, automobile, power washer, room-person ratio, subscription to daily newspaper, education of wife and husband, and church participation. These items are scored so that the presence or absence of these characteristics within a family unit will indicate the relative socio-economic status of the farm families contained in the study. For a complete analysis of the scale construction and items see, "A Short Form of the Farm Family Socio-Economic Status Scale," *Rural Sociology*, Vol. 8:2, June, 1943, pp. 161-170.

[5] A further sub-classification of part-time farmers was made on the basis of their long-term interest in carrying on the practice, and the economic relationship of their off-farm work to their farming operations. These divisions consisted of: (1) "Expanding Farmers," made up of individuals who engaged in off-farm work as a means of building up their farm with the intention of going into full-time farming in the future; (2) "Farming-Working," made up of individuals who considered it as a "Way of Life" with both the farm and nonfarm work necessary to their economic livelihood; and (3) "Hobby Farmers," consisting of persons of moderate and relatively high economic means, who engaged in the practice primarily as an avocation and were primarily dependent upon their nonfarm source of income. An analysis of differences in attitude orientation among these three groups was also carried out.

picture attendance averaged slightly more than once a year for both groups with the advent of television the reason most frequently given for the low rate.

While the full-time operators were traditionally Republican in their affiliation (53 per cent), part-time farmers differed by affiliating more frequently with the Democratic party (37 per cent) and Independent (33 per cent) than with the Republican (30 per cent).[6] The influence of the off-farm work situation, especially where union membership was required, appeared to have considerable effect on political affiliation among the part-time group.

Membership in farm organizations was significantly greater among full-time operators (35.4 per cent) than part-time operators (17.9 per cent). However, both groups were vocal about the lack of interest in the small farmer which they felt characterized the large farm organizations. The lack of membership by the part-time operator might be construed as a lack of identification with the full-time farmer and his problems. Such an interpretation might be warranted except for the relatively low membership and nominal participation of full-time operators in such organizations. Tradition rather than specific benefits was the reason most frequently given by those having active membership.[7]

Although 70 per cent of the part-time operators were born on a farm, the part-time farmer is more apt to have been born in a town (15 per cent) or city (15 per cent) than the full-time farmer. Only 9 per cent of the full-time operators had nonfarm birth places.[8] When father's occupations of both the operator and his wife are considered, 46 per cent of part-time families have a history of farming as compared to 78 per cent of the full-time families. Neither the operator's father nor the wife's father engaged in farming among 19 per cent of the part-time farmers and 2 per cent of the full-time farmers.[9]

The visiting pattern of the part-time farmer differed significantly from that of the full-time farmer. The part-time farmer less often restricted himself to visiting only fellow farmers and visited much more frequently (28 per cent) with persons employed in other occupations than did the full-time farmer (9 per cent). Fellow workers in the nonfarm work situation appeared to be the major source of nonfarm friendships among part-time operators. The differential association of the part-time farmer

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[6] $p < .02$, $c = .34$. In this notation p indicates the level of significance and c is the degree of association based on the corrected value of the contingency coefficient which approximates r.

[7] $p < .02$, $c = .27$

[8] $p < .01$, $c = .40$

[9] $p < .01$, $c = .42$

in social visiting would be an additional source of nonfarm attitudes, interests, and problems.[10]

All of the part-time farmers in the sample were married while 7.1 per cent of the full-time farmers were single.[11] The single full-time operators were those who had taken over their parents' farm while the father went into semi-retirement, and in most cases still retained part or full ownership. Although part-time farmers were more frequently married, they tended to have a smaller family than the full-time operators,[12] as 62 per cent of the part-time farmers had 3-or-less children compared with 44 per cent of the full-time operators. The older age of full-time operators may account for more completed families and a higher average number of children.

The conception of the part-time operator as the marginal individual in the farm population, which largely resulted from the series of studies in the 1930's, is not supported by the data on socio-economic status of part-time and full-time farmers in the Twin Cities area. Among the part-time farmers 26.9 per cent rated high, 53.7 per cent medium and 19.4 per cent low on the Sewell scale, while the percentages for the full-time operators were 10.3, 64.9, and 24.7 respectively. Several of the part-time farmers with high socio-economic ratings were professional and businessmen who operated "hobby farms." Even if this group is excluded from consideration the part-time operator rates higher on socio-economic status than the full-time operator.[13]

Economic differences. The type of farming practiced by the part-time farmer does not differ from that of the major type of farming practiced in the area. The dominant factors in determining the type of farming practiced appear to be the allied manufacturing, processing and commercial facilities, and the farming background of the part-time operators, most of whom are native to the area, rather than the nature and requirements of the off-farm job.

The average size of the part-time farm was 72 acres, 45 of which were under cultivation compared with an average size of 110 acres and 72 under cultivation for the full-time operator. The majority (51 per cent) of the part-time farmers had between 40 and 120 acres. Only 12 per cent had more than 120 acres compared with 37 per cent having more than 120 acres among the full-time farmers.[14] Gross farm income averaged $2,960 for the part-time group and $7,430 for the full-time operator. Although the discrepancy is rather large the economic picture for the part-

[10] $p < .001$, $c = .43$
[11] $p < .01$, $c = .32$
[12] $p < .01$, $c = .36$
[13] $p < .05$, $c = .31$
[14] $p < .01$, $c = .24$

time operator brightens when the average off-farm cash income of $3,678 is added to the farm income. Slightly more than one fourth (26 per cent) of the part-time farmers earned in excess of $5,000 at their nonfarm jobs.

In addition, 51 per cent of the part-time farm families reported other members besides the operator were working at nonfarm jobs as compared with 17 per cent of the full-time operators.[15]

The difference between full-time and part-time farmers was not only in of terms of the number of days worked off the farm but also in the type of off-farm work. The part-time operator was found largely in the skilled (46 per cent) and semi-skilled (28 per cent) areas while the full-time operator worked at clerical (16 per cent), unskilled (18 per cent), and custom agricultural work (45 per cent).[16]

The part-time operators also had a higher rate of farm ownership than the full-time operator, 88 per cent and 81 per cent respectively.[17]

There were no significant differences in the attitudes of part-time farmers and full-time farmers towards the type of government support program preferred. Slightly more than a third of each group preferred rigid supports, approximately a third flexible supports and a fourth of each group would like to see supports dropped completely. Both groups were practically unanimous in support of the thesis that agriculture is the backbone of the economy.

Differences in attitudes towards basic social institutions. Both total and partial association techniques were used in the analysis of the Rundquist-Sletto Scale scores on the family, law, education, and business. Eight independent variables, (1) type-of-farming operation (part-time, full-time), (2) religion, (3) education, (4) age, (5) socio-economic status, (6) political affiliation, (7) union membership (part-time farmers only), and (8) farm organization membership were analyzed to determine their relationship to attitudes in each of the four areas. The results of this analysis are summarized below.

Total Association

Attitudes towards family institution. No significant relationships were found between any of the independent variables and attitudes towards the family. The percentages of favorable and unfavorable responses among the independent variables were rather constant, with some variation with age. The younger and old-age groups expressed somewhat less favorable attitudes towards the family than did the middle-age group. Also the proportion of favorable responses towards the family increased

[15] $p < .01$, $c = .51$
[16] $p < .01$, $c = .74$
[17] $p < .02$, $c = .34$

with educational attainment. However, these differences were not statistically significant at the .05 level.

Attitudes towards law. Two variables, education[18] and type-of-farming operation (part-time, full-time)[19] showed a significant association with attitudes towards the law while the remaining seven did not. The more highly educated group had a much greater percentage of favorable responses than did either the medium- or low-education groupings. The part-time farming group, also, showed more favorable attitudes towards law than did the full-time farming group.

Attitudes towards economic institution. The factors age[20] and education[21] showed a significant association with attitudes towards the economic institution. Among the age groupings, the difference existed largely between the younger age grouping with 95 per cent favorable and the older age groups having only 78 per cent favorable. Among the education groups, the high group had 97 per cent responding favorably, the medium group, 81 per cent, and the low group, 70 per cent. The only other variable of the remaining seven to approach significance at the .05 level was the factor of political affiliation, the Republican and Independent had a more favorable attitude toward the economic institution than did the Democrats.

Attitudes towards education institution. Among the eight variables considered in the total association analysis with attitudes towards education, only type of *part-time* farming[22] and educational attainment[23] were significantly associated with the dependent variable. The percentage of favorable responses towards education increased from the low (0-7 years) group to the medium group (8-10 years) to the high group (11 years and over). Among the part-time farmers, the "hobby" group, who rely primarily upon their nonfarm employment, were the most favorable, and the "expanding farming" group, those who intend to go into full-time farming in the long run, and hence, may not value education so highly, tend to be the least favorable. The only other factor to approach statistical significance at the .05 level is that of socio-economic status with the high group somewhat more favorable in their attitudes towards education.

Partial Association

Where an independent variable showed a significant relationship on the basis of total association a mechanical partialing was carried out to

[18] $p < .02, c = .33$
[19] $p < .05, c = .24$
[20] $p < .05, c = .29$
[21] $p < .02, c = .32$
[22] $p < .05, c = .47$
[23] $p < .01, c = .35$

determine the extent to which the relationship held when the influence of other variables was controlled. The sample size prevented controlling more than one variable at a time. The degree of partial association was measured by computing the Chi-square value for the two-fold tables in the subsamples and where significant differences were found *c* was computed.

In the total association analysis two variables, education and type-of-farming operation showed a significant relationship with attitudes towards law. For purposes of partial analysis education was dichotomized into high (above 8th grade) and low (8th grade and below) and controlled, while type-of-farming operation was allowed to vary. Under these conditions, type-of-farming operation showed no significant relationship to the dependent variable of attitudes towards law. This indicates that the variation in attitude from part-time to full-time farmers in the zero-order analysis was a function of the variation in education rather than in type of farming.

In the partial analysis of attitudes towards education with education controlled and part-time farming, categorized into "hobby," "farming-working," and "expanding," permitted to vary, there was no statistically significant association between type of part-time farming and attitudes towards education as was the case in total association analysis, indicating that variation in attitude towards education was largely a function of education attainment. However, the relationship of education attainment[24] with favorable attitudes towards law when controlled on the basis of type-of-farming operation (full-time, part-time), is significantly associated only in the full-time farming subsample.

The variables of education and age showed a significant relationship to attitudes towards the economic institutions in the zero-order analysis. However, controlling on education (high, above 8th grade; low, 8th grade and below) and permitting age (20-49, 50-over) to vary results in no statistically significant differences in the subsamples indicating that the variation in attitude is also largely a function of educaton rather than age. Controlling on age (20-49; 50-over) and permitting education to vary (high; low) a significant relationship is found in only the age group 20-49[25] with the high-education group being very favorable in their attitudes as contrasted with the low-education group.

Only the variable of education remains significantly related to the dependent variables under conditions of partial association and only within two of the subsamples, full-time farmers attitudes towards law and the 20-49 years-of-age group's attitudes toward the economic institu-

[24] $p < .05, c = .32$
[25] $p < .02, c = .40$

tion. In both samples the higher education group has more favorable attitudes.

Summary

The part-time farmer differs significantly from the full-time farmer on a number of objective characteristics such as age, education, socio-economic status, farm ownership, type of off-farm work, marital status and family size. Even though these differences exist they do not appear to have an appreciable effect in creating different attitude patterns among part-time and full-time farmers.

On the basis of the absence of significant differences among part-time and full-time farmers with respect to social attitudes, the thesis that the part-time farmer is a cultural hybrid and contributes to instability in the rural structure appears questionable. A fruitful avenue for further research might be to determine the degree to which the part-time farmers' urban participation tends to be nominal or passive, and thus results in little influence on his attitudes and behaviors outside of the immediate work situation. His reference group appears to be mainly that of the full-time operator.

A factor that may account for lack of significant differences is the extent to which part-time farmers are recruited from the full-time farm population, either as sons of farmers economically unable to engage in full-time farming, or as farmers on the brink of retirement, who have reduced their scale of operations and who engaged in off-farm work in order to supplement their small farm incomes. The individual of urban background without farming experience engaging in part-time farming was an extremely rare occurrence.

Plausibly, persons engaging in part-time farming (e.g., "hobby" farmers) may have, in addition to economic motivation, a personal value orientation in accord with the value orientation of full-time farmers and the rural social structure, thus contributing to homogeneity rather than heterogeneity.

BEEF MARKETING IN SANTIAGO, CHILE*

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THIS study illustrates the relevance of political analysis for economics.[1] Here a number of policies regulating beef marketing in Santiago, Chile, are shown (very probably) to have considerable significance on economic development. Political analysis then asks: How flexible are these policies? Research seeks to show the origin of the policies, the way in which the policies are made in the political process, their rationale, the pattern of groups which appears consciously to favor or oppose them, the groups potentially involved (those which logic seems to say should be interested even though they show little signs of it), and the changes in all of these over time. Some of these questions can be answered fairly adequately, some of them only imperfectly, and some hardly at all. Indeed, some of the relevant questions will probably never be fully answered; for politics finally remains an art. Nevertheless, the writer believes that enough can be learned in inquiries like this to vindicate efforts jointly between economists and political scientists to probe the significance of government and politics in economic life.

A bureau of the Chilean Ministry of Economy is called the Superintendent of Supplies and Prices (referred to here as S.A.P.—short for Superintendencia de Abastecimientos y Precios). In the waiting room of the chief's office a sign reads: "No se otorgarán nuevas cuotas de beneficio de ganado por encontrarse totalmente distribuídas las disponibilidades. Se ruega no insistir." Freely translated, this means: "No new quotas for slaughtering livestock can be granted. Please do not insist."

A Santiago housewife buying beef is limited by her budget, but hers is the first or only act in the series from the auction to the butchershop (carnicería) that is unregulated by government. The sale for slaughter of calves and of cows less than five years old is prohibited. The number of beef animals that can be slaughtered is limited, and slaughtering in Santiago is restricted to two days each week. The number of entrepreneurs (industriales) who purchase and slaughter animals is limited. The slaughter house is a closed shop and the union (sindicato de matarifes), although not so decreed by government, is a closed union. Butchers (carniceros) must be licensed by the municipality under regulations imposed by the government of Chile. Finally, consumers prices are fixed,

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[1] Appreciation is due to the many persons who generously contributed time and special knowledge to this research. Although the writer is solely responsible for the interpretations of this paper, he wishes to express his gratitude for all those who helped the inquiry and especially to Raúl Yver O.

and the government employs 60 inspectors to enforce these maximum prices and similar regulations.

Why These Regulations?

Consumer price fixing dates from the Popular Front Government (1938) and was designed, along with other maximum prices, to benefit low-income consumers. In part these regulations seem to have been a reaction by a government of leftist tendency, resting on mass support, against the former ruling class, of which the prototype in Chile has always been the fundo (or plantation) owner. In part such regulations helped make up the general policy of stressing industrial development in Chile at the expense, if necessary, of agriculture.

The system of slaughtering quotas was precipitated in 1948 chiefly by the shift of Argentine beef from the Chilean to the British market.[2] Quotas and licenses (patentes) for butchershops were meant to distribute a scarce meat supply more evenly throughout the year, more equally among butchers, and more equitably among consumers. Controls such as beefless Tuesdays in Santiago restaurants were aimed at reducing beef consumption especially among upper income groups, and proscriptions of slaughtering cows and calves were designed to build up cattle herds.

Social arrangements sometimes live on after the reasons for instituting them have disappeared or have been reinterpreted with different inferences for policy. Argentine cattle and frozen beef are currently available at relatively low prices in any quantity that Chile wants to import in order to supplement its own beef production. Meanwhile, Chilean cattle numbers, which had been below 2,400,000 in 1942-1950, reached a low of 2,186,000 in 1951, but then rose to 2,560,000 in 1956.[3] The rise in numbers since 1951 has been explained as resulting from freeing the prices on live cattle.[4]

In addition, the 1956-57 drought in South Chile is an argument for removing slaughtering quotas on cattle in order to reduce the cattle population and to bring it into line with feed supplies. Meanwhile, doubt has been thrown on the rationale of the regulatory program in that it has been accompanied by a decline in per capita beef consumption.[5] That

[2] During 1943-1948, Chilean imports of beef cattle averaged 172,600; in 1949-1954 they averaged 74,500. (S.A.P.)

[3] S.A.P.: March 7, 1957.

[4] República de Chile, Ministerio de Agricultura, *La Agricultura Chilena en el Quinquenio 1951-55*. Capítulo VII (draft).

[5] The 8 years preceding slaughtering quotas (1941-1948) saw an annual average Chilean beef consumption of 23.9 Kgs. The 8 subsequent years (1949-1956), only 18.7 Kgs. (S.A.P.—March 7, 1957). These figures are a bit misleading as in 1949, at least, a sharp drop in consumption probably would have to have followed the shift in the Argentine supply, and the last three years (1954-56) have shown a steady rise

is, the program is supposed to benefit consumers, but they actually find themselves eating less beef.

If some reasons for introducing marketing controls have disappeared and other reasons now seem unconvincing, new reasons or, at least, new explanations for maintaining the controls are at hand. A system of vested interests has been created. These interests are the *industriales*, the slaughterers and their union, and the regulating and enforcing agency (S.A.P.). They constitute a system because they are all interrelated and held together by mutual favors and by common beliefs, that maintenance of the regulated market is practicable, necessary, and equitable.

Reasons for Eliminating Regulations of Beef Marketing

The most compelling reasons for eliminating marketing restrictions assume that this step would increase the consumption and stimulate the production of beef. Nutritionally, this development would help fulfill recommendations that the Chilean diet needs more animal proteins.[6]

Increased beef consumption is also made advisable by the rise in Chilean population and also by the policy of increasing agricultural production in order to save foreign exchange.[7] During 1946-56, Chile's importation of agricultural products increased from approximately $39,000,000 (U.S.) to $64,000,000 while her agricultural exports declined from $38,000,000 to $19,000,000. Chile is deficient in wheat, meat, oil, and milk; which among agricultural products take most of her foreign exchange. If an economic increase in the production of any of these is possible, it clearly should be made.

Economic Possibilities in Cattle Production and Beef Consumption

The writer believes that significant savings might be made by introducing economies in the process of slaughtering cattle and marketing beef. The following arguments rest on two assumptions.

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in consumption to 20.5 Kgs. Moreover, these figures should be compared with figures on the total animal protein consumption.

[6] International Bank for Reconstruction and Development, and the Food and Agriculture Organization of the U.N., *The Agricultural Economy of Chile*, Santiago de Chile and Washington, D.C., 1952, p. 65. There is a somewhat different interpretation in *Comisiones para el Plan de Desarrollo Agrícola*, Santiago de Chile, Abril, 1953, Tomo III, pagina 16 and following.

[7] The writer believes that the possibilities of heavier cattle and beef importations from Argentina are a distinct possibility. One person interviewed who owns both fundos in Chile and estancias in Argentina said that the 1,000 pound beef steer which he could produce for 22,000 pesos in Argentina costs 85,000 pesos in Chile (both figures in Chilean pesos, March, 1957). A study might be made projecting the effects of free trade between Chile and Argentina. The factors of production that would probably be shifted, the costs and saving in foreign exchange, the markets for different products lost and gained by different sectors of the Chilean economy, etc.

First, the marketing process in that part of Santiago served by the municipal slaughterhouse is assumed to be representative of marketing in the urban sectors of Chile generally. Second, an assumption is made that margins in the process can be cut by one-half.

One set of figures on the costs of marketing beef in Santiago indicates that on a 550 kilogram steer:[8]

	PESOS[*]
Slaughtering labor costs approximately	2,000
The industriales' profit is	8,178
The carniceros' margin is	42,680
Total	52,858

[*] The free exchange rate fluctuated around 600 pesos to the dollar when these figures were compiled.

If these margins are cut by one-half we get 26,429 pesos, which is approximately 21 per cent of the total 125,880 pesos that the butcher, in this example, receives for the beef. These figures may be quite incorrect, but they come from an informed source, and another set of figures gives nearly the same result.[9]

The assumption that a fifty per cent cut can be made in the margins is not proven; and, indeed, can be finally proven or disproven only by the results if controls, as recommended later, are removed. Some preliminary proof should result from further analysis, assuming that salient facts can be established as is later indicated to be desirable. The municipal slaughter house was designed to process 1,000 animals a day, but the daily quota is now nearly 1,500. Even with the present facilities, substantial unit costs savings should be obtainable from reducing the number slaughtered in any one day to 1,000 but also from increasing the number of slaughtering days and the total number of animals slaughtered. Savings from more efficient use of the by-products should also be considerable. The largest savings would come, in this example, in the carnicerías' operation. Of the carnicerías, or butchershops, a ranking official of the governmental control agency recently said: "We know how much beef Santiagoans will consume and we can translate this into cattle. We know that a butcher must sell two whole carcases each week to live, so we divide

[8] The date of the calculations is about October, 1956.

[9] As later indicated, disagreements about the terms of beef marketing suggest the need of an inquiry to establish the salient facts. Another set of cost figures supplied by S.A.P. has the consumer paying 106,350 pesos for 290 kilos of meat from a 500 Kg. steer. The margin of the industriale according to S.A.P. is 9,965 pesos, labor costs are 2,200 pesos, and the butcher's margin is 19,350 pesos. Totalling these, and again assuming that a rationalization of the process would permit a 50 per cent reduction in unit costs, the same meat could be sold to consumers for 90,563 pesos or nearly 15 per cent less money.

the number of cattle by two, and the result is 1,200. We license 1,200 butchers."

If this picture of paternalistic controls could be replaced by one of free competition, would the price to consumers be driven down? If a representative number of butchershops could be studied, cost figures obtained, and budget analysis applied, the writer believes that substantial savings in unit cost would appear possible in butchershops designed to handle more meat—perhaps two and one-half or three times more meat—than the present ones.

To the extent that margins are reduced and prices to the consumer lowered, an increase in demand would take place. If we assume that for every percentage drop in price the quantity demanded increases one per cent and if prices of the various cuts could be reduced by an average of 15 to 20 per cent, then the quantity demanded should increase proportionately. This assumption rests on the further assumption that most of the 15-20 per cent could be applied in reducing consumer prices—that not much of it would be needed to increase producer prices in order to bring forth more beef. Would farmers produce more beef at present prices, other things (especially the weather, with the 1956-57 drought in mind) being equal? The fact that the cattle population has increased considerably from 1951 through 1955 suggests that farmers would increase cattle production either without *additional* price incentives or with small incentives.

Suggestions for Reform in Beef Marketing

On basis of these economic assumptions, what steps are indicated to realize more beef production and consumption?

The Chilean cattle and beef market should be freed by removing the following controls and restrictions:

(1) The limitation on slaughtering cows and calves.[10]
(2) The slaughtering quotas in Santiago (and in the rest of Chile).
(3) Limitations of the number of slaughtering days.
(4) Restrictions on entry into the union of matarifes.
(5) Restrictions on the number of carnicero licenses issued.
(6) Restrictions of carniceros and of other retail establishments to selling only meat (or only bread, etc.)
(7) Consumer price ceilings.

[10] The limitations in slaughtering cows, in so far as they are enforced, may make difficult the culling of dairy herds by eliminating cows with low milk production records. Thus the Chilean plan for Agricultural development, 1954-1961, calls for an increase in average production of milk cows from 1,697.4 litres annually to 2.295 litres. Ministerio de Agricultura, Desarrollo Ganadero de Chile, 1954-1961, Santiago, 1954 (mimeo.) pp. 40-41.

If these controls were removed, the assumptions are that a larger number of cattle would move into consumption, that entrepreneurs would have an incentive, which is now largely lacking, to improve efficiency and to bid for factors of production, and to cut costs and prices.

Political Possibilities of Reform

For political analysis appropriate questions are: Who makes the relevant decisions and how difficult procedurally are they to make and to unmake? What forces are involved, present and potential, on both sides of the controversy? What is the influence of strategy and timing in the matter? Where and by whom is the decision made?

Who makes the decisions? Apparently the Minister of Economy and Commerce could wipe out the entire set of restrictions on cattle and beef marketing with a few strokes of his pen. This does not mean that other political institutions and influences are not involved, but it does suggest that no procedural bottlenecks exist. More difficult to analyse is the question: Who really makes the decisions, which in form are the Minister's? Inquiries suggest that neither the cabinet as a collegial body is involved nor (on this matter, at least) are powerful senators or deputies. Whether political parties would make the retention of marketing controls a matter of party policy is not so clear. Most informants thought that parties would not act in this way. What does seem clear, and is certainly logical, is that the President's office is involved. Probably, then, the President and the Minister of Economy can decide at any time to end controls on cattle and beef marketing.

What groups influence the decision? The interests in favor of the status quo seem to be the industriales, the slaughterers' union, and S.A.P. What groups favor the system? How strong these groups are politically depends on a number of factors most of which are extremely difficult to appraise. However, numbers count in politics; and we can ask: How large are the groups and how like-minded are they?

There are 84 industriales, other than cooperatives. Some believe that the industriales are solidly behind the system of controls. But one estimate holds that 10 per cent of them would prefer a free market. Other evidence suggests that some industriales would support, while others would probably passively accept, a change in the system. Very likely those few industriales who would prefer a free market actually process a considerable part of the beef in Santiago. Although it is illegal, a number of industriales rent quotas assigned to others (the going rental in early 1957 was reported to be 1,000 pesos per animal per day).

The union of matarifes is linked to the industriales by common interests. Three industriales' licenses, reportedly, are held by union members; and

the writer was told that the relationship between union and industriales is very close and harmonious. The size of the union is a controversial question. One well-informed source says that there are approximately 500 members plus 200 more who are not members but who are permitted to work in the slaughtering-house when extra labor is needed. Other sources put the union membership at higher levels such as 700, 1,000, or 1,500. All sources agree that the union is tightly organized politically and would respond as one man to protect the present system of regulation. It is not clear, however (although it is alleged by some informed persons), that the nonmembers would support the union; certainly they would seem to be a natural target for appeals against the present system. Nor is it clear that other labor unions would support the matarifes in defending controls, nor finally that the union which delivers the meat from the slaughterhouse to the carniceros, and which was forced in April of 1957 to replace its horse-drawn and unrefrigerated vehicles, would support the present system.

S.A.P. employs 576 persons. How solidly these persons would favor controls is not certain, but many informants cited S.A.P. as a strong supporter of controls.

What Groups Oppose Controls?

The National Society of Agriculture with 4,000 members opposes controls. According to its President, the Sindicato General de Dueños de Carnicerias takes the same position.[11] No information is at hand on the size of this group or on its solidarity—apparently the Sindicato is not solid enough effectively to support its president Valenzuela Bozo, who was an unsuccessful candidate for the Chamber of Deputies in 1957. Probably more significant is the opposition to the system of controls by some, at least, of the butchers' cooperatives, which are growing in size, and presumably, in influence.

Other critics include *El Mercurio, El Diario Ilustrado,* and (on its records of January-February, 1957) *La Nacíon;* various legislators[12]; and, according to interviews, a number of persons prominent in Chilean government and politics.

Thus, so far as *numbers* are concerned, those opposed to controls are not at an apparent disadvantage. But the groups favoring the maintenance of controls seem to be more closely knit and interlocked and are certainly in better communication with each other. Moreover, groups favoring controls may well enjoy more direct access to government—if it is true, as widely alleged, that many industriales hold their privileges in payment for political debts. However, as the presidential term approaches

[11] La Nacíon, January 30, 1957.
[12] Señores Valdés Larrain and Urrutia in the Chamber of Deputies, January 8, 1957.

its end, and in view of the prohibition against a president serving two consecutive terms, any political advantage accruing to superior access to the seat of power should progressively diminish. Finally, groups favoring controls have only to *maintain* an existing system, which is usually easier than to bring about changes.

Limitations on Group Analysis

The foregoing analysis suffers from obvious deficiencies. The writer has referred to groups as "for" or "against" controls whereas some groups may favor some controls and oppose others. (Although the butchers, for example, would probably like to see slaughtering quotas eliminated, many butchers would probably oppose free entry into the butchershop business.) The paper has not mentioned the "underlying" or "potential" groups which political sociologists are inclined to consider the most important of all groups. These latter groups would include the meat-consuming public, which would surely favor elimination of controls *after the fact*, if elimination were actually followed by more meat at lower prices. But part of this same public has long been politically courted by policies of control in the interest of "fair shares for all," and it is impossible to foretell just how the large public would react if controls were removed.

Timing and Strategy

Many are agreed that now is an excellent time to try for the elimination of marketing controls on cattle and beef. Since the election is past, political leaders can take a longer view and are not so pressed for political campaign funds which, it is widely alleged, the interests in favor of maintaining controls help supply. With the Chilean cattle population up and with feed cut by the drought, there is a supply of livestock that is expensive to hold off the market. The Instituto Nacional de Comercio (INACO) has a large supply of frozen meat in storage that would be available to prevent undue rises in price.

Strategy in this analysis refers to whether the opponents of controls would be well advised (a) to attempt the elimination of all controls at once or only some of them and (b) to seek to create political alliances for the purpose of ending controls. Logic seems to advise an effort to eliminate *all* controls at once. If a condition is to be created that leads people to act in a way that should reduce costs and prices, there must be a larger supply of beef; hence, quotas should be removed. If economies in the butchershops are to be achieved freedom of entry must be permitted; hence the license system should be eliminated. Some previous history, such as the removal of slaughtering quotas in 1954, also suggests

that the partial removal of controls is insufficient. One must recognize, of course, that it would probably be politically easier to remove only one control at a time because in this manner resistance might be confined only to those groups who would consider their immediate interests to be adversely affected.

In respect to the strategy of alliances, the writer was interested to observe that no effort has apparently been made by those opposing continuation of controls to form a combination. As already indicated, the building materials for an alliance are at hand. The absence of any effort toward alliance by those opposing controls is all the more surprising in light of the apparently closely integrated combination of industriales, matarifes, and administrators most of whom, at least, support the present system.

A Commission of Inquiry

The writer suggests the possibility of a commission (composed, as is understood to be customary, of members of the Executive and of the Congress), to inquire into the meat-marketing problem.

Many important differences exist among well-informed persons about facts salient to the analysis of cattle and beef marketing in Chile. Some of the wide differences of belief concern the following:

(1) The industriales' margin per animal.
(2) The amount of slaughtering labor necessary per animal.
(3) The value of an industriale's license.
(4) The extent to which industrial licenses are sold or rented.
(5) The butcher's margin per carcase.
(6) The size of the union of slaughterers.
(7) The degree to which there is freedom of entry into the butchershop business.

Inquiry should be able to establish the facts on the foregoing matters, but it is also important to discover the range of beliefs about the facts—the pattern of stereotypes. What beliefs are held and by whom about what facts? For example, many persons may believe that industriales profit are several times larger than they actually are. All such *beliefs*, are, in a very real sense, *facts* that policy makers must consider. If nothing else, establishment of these beliefs will show what kind of educational program is needed both in the event of an effort to remove controls and also in the event that the effort succeeds.

Policy makers should also be informed about opinions of participants and of the interested public in the question whether the present system of controls *should* be maintained or changed. However, when the inquiry

shifts from the facts and from beliefs about the facts to opinion about what ought to be it runs into difficulties. The techniques of modern public opinion analyses do not reveal such opinions with precision and they are even less effective in revealing how strongly opinions are held. Nevertheless, it would be useful to know how uniformly the members of various groups respond to questions about retention of the present system.

Finally there are politically sensitive questions that should be explored because they are relevant to policy making. Many persons believe that the regulatory system in meat marketing has produced a pattern of political contributions and of other payments to governmental officials for favors received. An investigation should be able to confirm or disprove these assertions.

Are some industrial licenses awarded in payment for political services? Are other industrial licenses awarded in return for regular "fees" paid to the enforcement agency? Does the industrial license carry an implied obligation to pay political assessments for campaign expenses? Is there favoritism in awarding butchers' licenses (patentes)? Are consumer price ceilings effectively enforced or are they rather systematically disregarded by arrangement with (and in return for favors rendered to) enforcement officers?

These questions suggest the need for a temperate and objective inquiry to establish the salient facts. It would be highly unfortunate if the inquiry degenerated into a witch hunt. The objective should be to understand the present system in order to inform policy makers bent on improving the efficiency of meat marketing in Chile rather than to find scapegoats to punish.

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REVIEWS

Distributing and Handling Grain Feeds in New Hampshire, George B. Rogers and Harry C. Woodworth. Agricultural Experiment Station, University of New Hampshire.

1. *Characteristics of Milling and Distributing Firms,* Station Bulletin 426, July 1956 pp. 28.
2. *Problems in Retail Distribution,* Station Bulletin 427, July 1956 pp. 59.
3. *Improving the Efficiency of the Grain Feeding Operation on Poultry and Dairy Farms,* Station Bulletin 431, August 1956 pp. 42.

These three bulletins, all published under the title of *Distributing and Handling Grain Feeds in New Hampshire* could well have been issued as a single book. If this had been done some duplication could have been excluded. However, experiment station considerations undoubtedly dictated the type of publication.

The objectives of the entire study were (1) to appraise the present system of assembling, distributing, and handling grain feeds; and (2) to explore ways of achieving greater efficiency in that system.

For readers who are unfamiliar with grain-feed marketing in a deficit grain-producing area such as New Hampshire and the New England area in general, the first publication is a good introduction through its analysis of the characteristics of milling and distributing firms. It discusses topics related to the market for grain feeds; assembling, milling, and distributing to retail outlets; company policies, pricing practices, and terms; and retail outlet characteristics.

Most readers will be interested in the chapter on company policies, pricing practices and terms. As the authors indicate, "Another significant point is the great importance of non-price considerations in competing for the farmers' feed business. Variations in formulas and performance make direct price comparisons a rather difficult task for the individual farmer."

This problem area is not only one of the most difficult to analyze but it may prove to be the area where the most valuable contribution can be made. Studies of the feeders' preferences for home-produced, custom-mixed (portable and stationary), and formula feeds could yield much basic information, especially if they included an analysis of how farmers make decisions to buy any given type of feed. Studies of the industry structure and practices for the past, present, and future potentials also appear to have value in this area.

The authors have not answered many of the questions that could be raised. However, they have set forth the major problem and have given

much of the background necessary to encourage further research. The more significant of these items include differences in industry terms for quality, set vs. varying formulas, service work, and company pricing policies, with charges or credits for delivery, cash payments, quantity, etc. The authors apparently overlooked an area that might be considered part of the credit policies; namely, the financing by the feed companies of broiler, egg, and other production. It might be that this important problem is not encountered by the New Hampshire industry.

Chapters on retail outlet characteristics, and assembling, milling and distributing to retail outlets are very instructive in describing the type of industry in New Hampshire. Readers from surplus areas will be impressed with the lack of a discussion on custom milling and will note the clear-cut definition for feed retailers. They will also notice the considerable reliance on the railroad and the importance of the intransit privilege. The intransit discussion is relatively long and detailed, but apparently well handled.

Problems in Retail Distribution, the second publication, opens with a discussion of the importance of location, delivery routing, and size and type of farms in determining volume. It then discusses in more detail the determination of a fair and equitable pricing practice. The authors constructed an interesting theoretical model for determining quantity discounts for bagged feeds, based on labor inputs. The chapter on delivery-route efficiency presents cost information for models with different loading and unloading equipment, route time and other delays, and discusses the importance of route duplication. At the same time, it recognizes that the establishment of exclusive territories is not possible, short of a national emergency. The authors found that using more than two men in loading a truck was inefficient and that doubling the man-minutes in travel, position, and collection are unlikely to be offset by increases in loading and unloading efficiency eventually realized by using two men on delivery trucks.

In the chapter discussing bulk vs. bagged handling, the authors conclude that bulk handling will not result in lower costs for most feed establishments operating in the state. Primary reasons are the size of order per stop and the expense of duplicating handling systems and routes, although many advantages and disadvantages are discussed. They also imply that the discounts for bulk may overstate the actual savings in costs and may be reduced after the introductory period is completed.

Improving the Efficiency of the Grain Feeding Operation on Poultry and Dairy Farms, as one might expect, is full of simple flow diagrams or models and suggestions for given types of equipment and plant layout. In view of the position taken by the authors relative to the lack of any sizable savings in the New Hampshire feed plant or retail store, the

reader does not expect the extensive discussion of bulk handling on the farm. Savings in bulk handling on the farm in terms of cash, convenience, and time apparently may force an increase in bulk sales in New Hampshire. This also explains the authors' discussion of handling feed in bags at the plant, store, and truck, but emptying the bags for bulk handling on the farm.

Research workers will learn much about this industry by referring to the reports. The time involved will be well spent, especially for those engaged in grains and feeds research.

V. JOHN BRENSIKE

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The Great Plains in Transition, Carl Frederick Kraenzel. Norman: The University of Oklahoma Press, 1955. Pp. xiv, 428. $5.00.

The thought-arresting feature of this book is its description of social and economic problems arising from the characteristics of climate or of any other basic cause in any area. Dr. Kraenzel's description of the problems of the Plains sharply etches the area into a national pattern of progress and yet clearly sets it apart as to the processes by which people adapt their cultural pattern to their surroundings. He notes that the generally accepted national solutions to problems do not operate successfully in a natural environment such as prevails in the Great Plains of America.

The book lays the groundword for a thought pattern leading to a basic program giving the people who live in the Great Plains a good continuing standard of living, rather than to have feast and famine, which is met with a hit-or-miss, year-to-year series of emergency activities. It is clear that programs of individual families or the entire Plains community must be on a twenty-year basis. Experiences of the past twenty years and twenty years before that show that in the course of a score of years the well being of Plains families will have been in jeopardy about one-half of that period and on a high level during the other half.

A new definition of semi-aridity, evolved by the leaders of thought in the area, is basic to Kraenzel's approach. The definition puts aside the common concept of dry lands being poor lands and substitutes in lieu thereof the concept of rich land and poor land with super crops in some years and crop failures in other years. The impact of a rich-land/poor-land resource cannot be measured in financial terms alone. Whole generations of children may go without an education because of the low tide of the economy within the area. This can be alleviated, however, if institutional adaptations are included in a rational and well-founded program.

People who live in an area that has unusual conditions must go through several stages of adaptation, first in their thought pattern, then in their farm and business plans and finally in the actual operations. Social and political history shows that the first generation of settlers of the Plains experienced difficulty in modifying their ideas about self-sufficient households and manner of cultivating the land. They were disappointed with the family garden, the family dairy, and with other elements of self-sufficiency. The new entrepreneur found himself facing adaptations in his way of living, and the present generation is in the process of furthering the reorientation that was so painfully begun by some of the more foresighted of the original settlers.

The author makes the point that the Plains, with its problem intensities, is somewhat of a social and economic laboratory. It is true that several nationally accepted adaptations were tested there. When the agricultural structure of the Plains broke down, Dr. M. L. Wilson set up an experimental economic research project to study lower cost by obtaining greater productivity per man hour. The findings shattered the traditional concept of long hours and numerous lines of production as the way of life on American farms. Another instance was an ingenious device used by an assessor in a sparsely settled county for getting in the tax returns. It gave proof that citizens would readily take responsibility in public affairs. The principle has been generally incorporated in the administrative procedure for agricultural programs of the entire county.

Kraenzel notes that the Plains people are a minority group in the councils of the nation. For instance, when states are grouped into regions for consultation purposes the area boundaries are not shaped according to problems that are predominant but rather the states are grouped for convenience of communication. Perhaps the lack of north and south communication has a bearing on lack of opportunity for scientists, educators and others, to give systematic consideration to Plains problems. Traditions are strong and certain of these that dominate national life are caused to bear down on minor segments of society whose members, because of convenience of communication, are attached to groups who are concerned with other complexities and other problem patterns.

The author's points can be grouped into steps for placing the evolvement of well being for Great Plains' residents in its proper perspective:

1. A type of education that makes the problems clear and provides processes that isolate certain aspects of the problem so that people's thinking may encompass manageable segments and may begin to form thought patterns that will lead to remedial action.
2. Specific economic and social testing and experimentation both in the organization of individual enterprises and public institutions. The

testing takes into account new combinations of inputs to make use of mechanization, low-cost operation, efficient public facilities and other new features.

3. Widespread participation of the citizens in analyses and study of their economic and social surrounding, bringing forward the useful experiences in adapting themselves to the area and enabling them to be cognizant of a common interest at a given time and to formulate remedies accordingly.

4. A "building-in" process whereby stabilities of various kinds are made a part of the economic and social structure. The building in of stabilizers includes water conservation, whether by summer fallow or by major impounding structures, establishment of a tax base resting on the productivity of land, the consistent prevention of wind erosion, a credit program that allows for ups and downs of repayment ability, a rearrangement of school districts, the use of range management patterns and other measures fitted to the conditions.

Kraenzel's portrayal of the Plains and its problems makes clear that there must be a continued up-surgence of analytical thought and leadership within and outside the area if the problems are to be isolated and analyzed, the remedies formulated, and the legal and financial prerequisites set up for strengthening the Great Plains, not so much in terms of one year but for twenty-year periods.

ELMER STARCH

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Agriculture in an Industrial Economy: The Agrarian Crisis Today, Troy J. Cauley. New York: Bookman Associates, 1956. Pp. 191. $4.00.

Professor Cauley's preface states that he has "tried to apply the principles of what has come to be called 'institutional economics' . . . to the problems of agriculture. . . ." He has written an interesting book, and one that should be assigned in a "principles" course to allow students to know that there is another side to the story told by their traditional texts. To say that Cauley has not fully succeeded in applying the principles of institutional economics is no criticism of the book, but rather of his too-optimistic prefatory claim.

Obviously, Cauley, in this slender volume, can only make a start on such a large assignment. The book can be considered mainly as a supplement to other texts. It is in that role that this reviewer considers it valuable.

The first matter of business in Cauley's book, is the description and then the destruction of the "articles of faith" upon which partically all "accepted" economic theory depends. In summary, these articles consist

of two *a priori* assumptions involving man and nature, and two simplifying assumptions regarding man's economic organization.

The *a priori* assumptions: (1) that nature has provided relatively limited resources to man, whose wants are relatively unlimited; and (2) that man is a hedonistic creature,[1] and that his rational hedonism will lead him to act "economically" in his production and consumption decisions.

In addition to these two assumptions derived deductively from an abstraction of a primitive world, traditional price theory has made two assumptions regarding man's economic organizations: (1) that factors of production will be mobile, and (2) that competition will be atomistic.

The true nature of modern economies, correctly recognized by Cauley, is completely different. Productive potential is ubiquitously embarrassing, relative to "demand." Factor underemployment is therefore the outstanding characteristic of modern societies, even those that boast of having virtually no jobless workers. Peoples' wants are so far from limitless, relative to resources, that a large portion of the activities of modern societies is devoted either to "creation of new wants," planned obsolescence, or suppression of potential production. Factor mobility is technologically impossible. The departure of real societies from atomistic competition is now so well known that even the business press has coined a phrase, "workable competition," to describe reality.

Institutional Economics, which attempts to describe reality, therefore must be complex. It cannot be woven around a framework of simple organizing principles comparable to those of traditional price theory. Such principles as are agreed upon by the leading institutionalists are of an entirely different type. Cauley, perhaps to keep his text simple, has not made these differences sufficiently clear.

He has, however, postulated one major "principle" of institutionalism that a society to operate successfully must secure, through any of the legal and institutional means at its disposal, a "functionally adequate distribution of income." This somewhat awkward phrase means simply that society must plan and control distribution of income so that the economy will flourish, producing continually more goods and services, and distributing them more equitably. The various important "functions" in society must be adequately rewarded (both for reasons of justice, and

[1] Notwithstanding the attempts of modern theorists, through the "indifference approach" to circumvent or abandon hedonism, it remains a foundation stone of the price theory of value, as Ayres, and others have clearly demonstrated (cf. C. E. Ayres, *The Industrial Economy*, New York: Houghton, 1952, pp. 329-339). The other social sciences, more intimately concerned than economics with defining, discovering, and measuring such human characteristics, have long ago declared the concept to be without any foundation whatsoever, as an organizing principle.

for continued productive efficiency). Agriculture, being an important function, should secure an adequate reward, equitably distributed.

Such a "principle," of course, contains words whose definition and quantification are for "political" decision, defying precise economic treatment. To the traditionalist, Cauley is saying: "A major principle of a successful economic system is that income should be so distributed as to guarantee the continued success of the economic system." This seems to be circularity, or inexactness, or both, and to overemphasize income distribution while neglecting technological productivity. In the context of Cauley's book, however, his definition of "functionally adequate" not only makes sense; when tied to the institutionalist's "instrumental theory of value," it makes the only sense: that most of man's present "economic problems," both in underdeveloped and developed economies, would disappear if man knew how to utilize better what he is technologically capable of producing. This is not to say that problems would cease to exist. However the problems of the confused present and the perhaps more sensible future would be considerably different. The only thing they would have in common would be the fact that neither could be handled by what passes today, among the majority of the regiment, as "economics."

The author devotes entirely too many pages to a quarrel with some of the writings of T. W. Schultz. A better use of the space would have been to organize the criticism of policy suggestions by idea, rather than by name of major protagonist. In fact, Cauley overlooked Schultz's greatest weakness by not pointing out more sharply the extent to which Schultz bears, and exposes in spite of his "welfare sympathies," deep "articles of faith" with regard to the existence and dependability of the organizing principles assumed by traditional price theory. Cauley might well have criticized most of the leaders in the policy field on this ground. A valid generalization would be that even when the most illustrious "names" in agricultural economics occasionally make workable policy recommendations, it is usually for the wrong reasons.

Cauley strongly supports the Brannan Plan type of production payment. He acknowledges, however, that a better solution to the "agricultural problem" would be for the economy to be so prosperous, both domestically and internationally, that rapidly expanding consumer demand would make unnecessary more than occasional resort to specific income transfers to aid agriculture. Cauley reasons correctly that in a world with provable need for American agricultural abundance, the cost of solving agricultural-consumption and price-surplus problems should be considered a cost of improving our generally defective economic organization, acknowledged by the public to be such, rather than "farm relief."

Cauley's "institutional" text should have included considerably more agricultural economics, both from the micro standpoint we call farm management, and the micro standpoint called land economics. It should have included more material on the subject of marketing, both of the agricultural products and of the things bought by farmers, more on transportation, agricultural labor, the special problems of low-income farmers, agricultural credit, farm working and living conditions, and resource development on an area basis—to mention only a few items with insufficient space in Cauley's book.

However, if there are still a few institutionalists not yet driven out of teaching, their unanimous adoption of the book as a supplement to traditional "principles" texts might prove encouraging enough to the author and the publisher to justify a more comprehensive effort in the future.

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The American Economic System, E. T. Weiler and W. H. Martin. New York: Macmillan Company, 1957. Pp. xxv, 623. $6.00.

This introductory textbook, a revised edition of Professor Weiler's *The Economic System* (Macmillan, 1952), follows the current trend to shorter principles books, which omit the long descriptive sections of the traditional omnibus American book. The new mode of introduction to economics has two parts: first, the main analytical ideas in economics—both micro and macro—are presented; and, second, the analysis is applied to a variety of problems, i.e. current issues of public policy—monopoly, inflation, and the like. In the main, description of institutions is introduced only to illustrate the meaning of an abstract idea or to explain the nature of a policy problem.

Of course, each book following this general plan has its own individual variations on the common theme of analytical economics. The book by Weiler and Martin is different from the others mainly in its heavy use of description, albeit of a rather abstract kind, as a central feature of the exposition. This expository device is the familiar circular flow, here used in many ways: for example, to picture the flow of resources to different markets (each represented by a demand-supply diagram), or again, to show the ways in which government activity touches economic life generally. Emphasis on analysis rather than on description in an introductory book is wholly desirable. In my opinion, *The American Economic System* deserves praise for following this plan. But I question whether extensive use of the circular flow idea makes the analysis easier to understand. Is it not relatively easy for students, using their own imaginations,

[a] The views expressed are solely those of the reviewer, and no responsibility is implied to any organization with which he may be associated.

to grasp the mechanical aspects of economic interdependence, once they understand the fundamental notions of scarcity and price? Of course, at some points—in expounding the place of financial intermediaries in economic activity, for example—simplified description of the entire economic system is crucial, and in such places the diagrams of circular flow are quite helpful. But to organize an entire introductory book around such diagrams seems unnecessarily cumbersome. For one thing, presentation of the descriptive apparatus itself requires the first 3 chapters (more than 50 pages).

The book is well constructed as a "principles of the American price system." There are sections on resource allocation (6 chapters), over-all stability (5 chapters), organized economic groups (5 chapters), international economics (3 chapters), and—the chief novelty in this respect—economic growth (5 chapters). This latter subject, so much the current fashion, is integrated well with the main theme: special problems of secular economic change are presented, but always in relation to the fundamentals of a price system. The book's comparative advantage is probably greatest in the section on resource allocation. This gives an orderly account of market price, production, and income distribution, including a chapter each on monopoly and government.

Judged by the standard of the allocation chapters, the section on aggregative stability is disappointing. The "determination" of national income is discussed in Keynesian terms, with no indication whether the variables are measured in real or money terms. Although this point is left vague, some hint may be gained from the fact that "output" and "production" are said to change but price changes are not mentioned until a paragraph near the end of the chapter. And at this point all that is said on prices is that the preceding analysis ". . . show[s] something of the process of inflation." (p. 242)! In this environment of vague makebelieve, it is no wonder that underemployment equilibrium lives on ("But so long as investment and the propensity to consume remained the same, the level of national income that had been established would continue despite the presence of unused resources."—p. 242). Nor is it surprising to read in the following chapter (Chapter 12, "Money and the Banking System") that although ". . . the role of money is not passive" (p. 267), it consists of levering the interest rate up and down (pp. 267-8). Even with this introduction, however, it is unsettling to have bank lending described, wrongly, as an offset to ". . . current savings in the money balances. . . ." (p. 268).

With matters explained thus, it is puzzling to come to the appendix of the next chapter (Chapter 13, "The Federal Reserve and the Functioning of the Economy") and find the equation of exchange presented as a

". . . very useful complement to the savings-investment approach of Chapter 11." (p. 287). The mystery is resolved, however, by the discovery that the equation of exchange, "Like any analytical device, . . . does not tell us what will happen. Rather it tells us what information we shall need if we are to predict what will happen." (p. 292). Thus the equation of exchange "complements" the saving-investment approach in the sense that anything said in terms of saving and investment can be rephrased in terms of M, V, and the rest. This is a prime example of "the taxonomic approach," the demerits of which need no comment here.[1] Perhaps some statements of a classificatory nature ("If supply increases, price will fall") are unavoidable in an elementary exposition of economic theory; but in the present case the discussion of the equation of exchange contributes nothing to the theory presented of the national income, and the role of money and prices is thereby left obscure.

All this makes an unsatisfactory introduction to aggregative economics. It is fair to say, however, that satisfactory presentations of these subjects are hard to find in textbooks, elementary or advanced, which commonly suffer from split vision, seeing income out of one eye and money out of the other with little or no resolution of the aggregative image of the economy.

In the section on organized groups in economic life, the agriculture chapter (Chapter 23) is very different in manner of treatment from the preceding chapters on monopoly and labor unions. These latter two chapters, especially the one on unions, are again examples of economic taxonomy: unions "may" do this and "may" do that. In contrast, the discussion of agriculture summarizes much relevant data and gives a good account of problems and policy. In discussions, even elementary ones, concerned explicitly with policy, it is of course especially important to make such positive statements as can be supported, and not to be content with a mere catalogue of possibilities. It is probably true that data relevant to agricultural problems are much more plentiful than relevant information on monopoly, business or union. But is it not, then, the most helpful course in an introductory book to state the relevant issues, presenting such data as are available and admitting the lack of information on other points? Surely it is in these terms that one wants to train college students to think for themselves about policy.

What does this appraisal of a new introductory book come to? The book is well constructed, especially good on resource allocation, weak on

[1] See H. G. Johnson, "The Taxonomic Approach to Economic Policy," *Economic Journal*, Vol. 61, December 1951, pp. 812-832; and Milton Friedman, "Lange on Price Flexibility and Employment," *American Economic Review*, Vol. 36, September, 1946, pp. 613-631 (reprinted in *Essays in Positive Economics*, Chicago, 1953, pp. 277-300).

aggregative economics, and disappointingly inconclusive on some policy questions. It has a section on economic growth, for those who think that this subject must be included in an introduction to the American model of the price system. The style seems generally good, although the student is frequently addressed as "you"—an unattractive mannerism in a textbook—and the authors several times lapse from English into long, small-print outlines, suggesting either redundant summarizing or shortness of breath—neither of which helps the reader make his way along. On the other hand, *The Wealth of Nations* is quoted in five different places, which is almost stylistic recommendation enough for an introductory textbook. There is no doubt that the book is up to date, that it reflects careful thought in general and specific matters, and that the authors have diligently brought together much relevant illustrative material. In short, it is a good introduction to economics, in many respects as useful as any one about the American economy and, in some respects, superior to most.

JAMES W. FORD

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Lowden of Illinois: The Life of Frank O. Lowden, William T. Hutchinson. Chicago: University of Chicago Press, 1957. 2 vols., pp. xiii, 767. $15.00.

Frank Lowden had a long life and a busy one. His eighty-two years extended from the Civil War to the Second World War. In the course of them he was teacher, lawyer, businessman, farmer, politician, Congressman, governor, and much else. He was repeatedly considered for other offices and scored a couple of near misses on the presidency.

He began as a poor boy, taught school so that he could go to college, went to Chicago at twenty-five, and began to work his way up. A turning point in his life was his falling in love with Florence Pullman of the sleeping car millions. The marriage catapulted Lowden into a style of living he might otherwise never have aspired to—a Chicago mansion, a castle on the St. Lawrence, a retinue of servants, a country estate on Rock River, and much travel by private car and abroad. Marriage into the aristocracy of wealth gave him business opportunities of incalculable advantage. It also redoubled his determination to succeed and, best of all, gave him an ideal helpmate. Thenceforth, his career was an interweave of business, politics, and farming. The greatest of these, Lowden always insisted, was farming, but what really characterized him was multiplicity of interests.

After a promising start as a practicing attorney he veered off into business, with early stress on monopoly building. He helped create the National Biscuit Company with its virtual corner on the cracker market,

for which he and three others shared a fee of $1,590,000. Like work for American Radiator netted another tidy fee. He had similar hopes for Shelby Steel Tube, but the bicycle craze waned, United States Steel put one of its subsidiaries into active competition, and Lowden was fortunate to salvage a small profit. Many of his investments were speculative. He lost $100,000 on assorted mines, $75,000 on the Springfield *News*, $9,000 to a smooth-talking promoter, $25,000 on a Veracruz warehouse, $17,000 on a rubber plantation, $93,000 on a Texas ranch, not to mention $380,000 "invested" in his campaign for nomination in 1920. Perhaps it is only to the low in income that these losses seem large. They were more than recouped by investments that paid off. His income never caught up with his wife's, but he made money and accumulated it, and his associates credited him with real business ability.

Friends put him into the race for Governor of Illinois in 1904, but he was too rich and too inexperienced to be the ideal candidate. In 1906 he was elected to Congress and served there five years. Another five years later he campaigned vigorously and successfully for nomination and election as Governor. His administration was heralded as Illinois' best, largely because of the reforms he pressed through the legislature. Most of the program came from an earlier committee report, but Lowden got it adopted and made excellent appointments. As a war governor he was less distinguished. He was bitterly anti-pacifist and roughshod in suppressing freedom of speech.

He is more notable for elections lost and offices declined. In 1920 he came within a whisker of nomination to the presidency and in 1928 he ran second to Hoover. Harding offered him a cabinet post or an ambassadorship. Coolidge and the party offered him the second place on the ticket in 1924. Coolidge wanted him to be ambassador to Great Britain. Hoover asked him to be Secretary of Agriculture, and Roosevelt and Wallace tried to get him to head the AAA. All these offices he declined, partly to preserve his eligibility for the main prize, and partly to retain independence of action. His spurning of all the intermediate rungs did not help him up the political ladder, and his "secessions" from some of the races seemed petulant and selfish. In retrospect it is easy to chart a more promising road toward the White House.

As a farmer Lowden was again mercurial. He preferred country life and liked to direct farm operations, but subject to so many interruptions and absences that he always had to have resident managers. At his 4,400-acre Rock River estate he had notable success for awhile with Shorthorns and later with Holstein-Friesians. He experimented successfully with forestry and unsuccessfully with chickens. He regarded his five and ten thousand acre plantations in Arkansas as prospective models, but they

did not attain that stature. Over the years he was a gentleman farmer who just about broke even on his farming.

Yet he was one of the most active spokesmen for the farmers. He was a member and officer in many agricultural organizations. He was a constant advocate of cooperatives, skeptical about the equalization fee device, but in favor of crop control through a bounty for putting land into legumes. In 1928 he seemed more intent on getting the right farm plank than on being President. Yet here also he declined the big posts and their responsibilities and preferred to remain a free-wheeling advocate and critic.

With all these multifarious activities, Lowden left a complex trail for his biographer to follow. Since he never thinned his files, they became a rich storehouse richly backed by the newspapers, public records, and the testimony of many who knew him. As all who have read William T. Hutchinson's *Cyrus McCormick* will take for granted, the research for the Lowden biography has been thorough and meticulous. The book is written straight and clear, in a style not influenced by Lowden's proclivity for florid persiflage. What gives the book backbone is that Hutchinson has a truly comprehensive knowledge of Chicago, the Midwest, and the nation throughout the course of Lowden's whole period and more, and a sufficient expertness on the great variety of undertakings in which Lowden tried to operate. The bits and pieces of his research findings are put on this solid framework.

Because Lowden tried to be so versatile, it is easy to criticize him as a dabbler or dilletante. The impression builds up that, had he hewed to one line, he might have been a great teacher, a topflight attorney, a leading tycoon, a political figure of first rank, a model farmer, or the most effective shaper of American farm policy. The proposition is not necessarily valid. Often he made decisions that undercut his effectiveness along a particular line, and he did not demonstrate that he was capable of sustained dedication and effort toward any one of these objectives. Perhaps he measured himself aright when he let his interests spread and change.

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American Families, Paul C. Glick. New York: John Wiley and Sons, Inc., 1957. Pp. XIV, 240, $6.00.

This book is one of the Census Monograph Series, sponsored by the Social Science Research Council and the Bureau of the Census. It is a welcome addition to an impressive series of books sponsored by the committee.

The contents of this book are revealed by the sub-title "A Demographic Analysis of Census Data on American Families at Mid-Century." The first chapter "Family Living Arrangements" starts with a brief review of the various types of "families" and then proceeds to group them into the manageable number of categories used throughout the book. The remainder of the chapter gives a description of family living arrangements in America. The following 10 chapters cover; Household and Family Composition, The Life Cycle of the Family, Changes in Family Composition During the Life Cycle, Social and Economic Changes During the Family Life Cycle, First Marriages and Remarriages, Marriage Rates and Number of Previous Marriages, Separation, Divorce and Widowhood, Future Household Formation, Future Family Formation and a Summary.

Although the book is based largely on the 1950 Census of Population and annual surveys, it is not simply a reshuffling of census figures. Because the author has had a great deal of experience with census material, he has been able to do a creditable job of interpreting the data, and throughout the book the author modestly suggests reasons for the changes that are taking place in American families. The analysis is primarily descriptive in nature. However, because of the thoroughness of his work I think the authors hope, "that others will find in the descriptive material a source for testing hypotheses," will be fulfilled.

Although this book cannot be recommended for bedside reading, it should be a valuable asset to many people. In the academic field it should be of particular value to sociologists and economists. In the nonacademic field it should be particularly useful to businessmen whose markets are influenced by changes in family size, composition and structure.

The strength of the book lies in its completeness of data relevant to American families on a national basis. Also the three appendices; Sources, Definitions and Explanations; Comparability and Reliability of Data; and Technical Note on Household and Family Projections, are excellent.

The shortcomings, if any, are that the book is rather difficult to read and information relative to regional differences is somewhat inadequate.

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Mecanización de la Agricultura Mexicana, por Luis Yañez-Perez, con la colaboración de Edmundo Moyo Porras. Instituto Mexicano de Investigaciones Económicas, Mexico, D.F., 1957, Pp. xvii, 416.

This is the first publication of the "Instituto Mexicano Investigaciones Económicas," established in 1953 to study problems of Mexican development. The purpose of the book is to determine the extent to which mechanization of Mexican agriculture is appropriate in the face of the rapid

increase in the country's rural population.

The first five chapters, each a separate entity in itself, are devoted to a description and analysis of the population structure, the land tenure situation, the relative productivity of agricultural labor under varying degrees of mechanization, and the extent of mechanization in Mexico. Chapters 6 and 7 discuss a possible program of mechanization during next 24 years and the cost of such a program. The final chapter is one of summary and conclusion.

In the first part of this book, which includes 118 tables, there is a great deal of statistical information on Mexican agriculture. There is painstaking and elaborate analysis of population increases, of changes in land distribution, and of results of experiments with fertilizers and seed. There is some discussion of increases in mechanization and of changes in other physical factors that influence agricultural output. The authors have also undertaken field studies to estimate the range in labor requirements on "more" and "less" mechanized farms producing a variety of crops.

On the basis of these data, the authors have synthesized the requirements of machinery during the next 24 years to the end that Mexican agriculture could be highly mechanized and the area of production could be expanded to absorb both those displaced by mechanization of existing holdings plus the natural increase in the rural population. The authors believe (1) that an expansion of acreage from 10 million hectares in 1950 to 21 million hectares in 24 years and (2) that an increase in mechanization from 4.2% of the area under cultivation in 1950 to 78.7% in 24 years' time would meet their requirements. This expansion would give Mexico one of the most highly mechanized agricultural systems in the world, and would create a demand for 4 million more agricultural workers, absorbing the 1.6 million displaced by mechanization and the 2.3 million new rural job seekers who will enter the labor market in the next 24 years. This program is expected to cost at least 13 billion pesos.

Although this work is the product of an economic institute, it is largely an exercise in juggling man hours, machines and acres to provide a neat solution to the problem of expansion of mechanization and of absorption of a given increase in labor supply. The work ignores the human problem of converting a large number of backward "campesinos," mostly engaged in near subsistence farming on holdings of less than 5 hectares, into commercial style producers operating and maintaining complex farm machines.

For present purposes, however, the salient feature of the study is its lack of appreciation of the economics of mechanization. The authors firmly believe that mechanization is the most important element needed to reduce costs of production and to raise the levels of living of Mexican

producers. In fact they cite the lack of mechanization of Mexican agriculture as proof of its backwardness. They do not appreciate that agriculture might be technically inefficient but that the price of some of the factors of production might be such that it makes economic sense not to follow a purely engineering viewpoint. The authors have not given any thought to the fact that the replacement of Mexico's plentiful supply of cheap, inefficient labor with high-cost machinery and scarce capital might raise costs of production in the country rather than lower them. Furthermore no consideration has been given to the relative costs of increasing output by more intensive farming of existing acreage rather than extending acreage, nor is there any explanation about how land and machines are to be combined to operate at optimum efficiency when the average size of holding in Mexico is between 6 and 8 hectares.

Although these and many other questions remain unanswered, the authors are to be congratulated on assembling this much data under one cover. The book is recommended as a handy reference on Mexican agriculture. Those who use it are warned not to be confused if they cannot find the table of contents, however, as this is at the end of the book rather than at the beginning.

MONTAGUE YUDELMAN

The Rockefeller Foundation

Town and Country Churches and Family Farming, Marshall Harris and Joseph Ackerman. New York: Department of Town and Country Church, 257 Fourth Avenue, 1956, pp. 102. $1.50.

Rural churches are caught up in the agricultural revolution now in process. The success of rural churches is closely tied to agricultural adjustments, to an understanding of agricultural problems and to conscious attempts to enter into the solution of these problems in rural communities. The rural congregation with effective leadership from its religious and lay leaders, who have entered into an understanding and redirection of agricultural adjustments, has been successful in maintaining and building a strong rural church organization. Other congregations that have tried to ignore or by-pass the agricultural revolution, have seen their organization disintegrate.

In recent years, the churches have recognized this problem and have endeavored to equip themselves to enter into its understanding and solution. The organization and effective work of the National Catholic Rural Life Conference and the Department of Town and Country Church of the National Council of Churches, are outstanding examples.

This book is the outgrowth of one and one-half decades of seminars and meetings on land tenure sponsored by the Department of Town and

Country Church of the National Council of Churches. The authors are eminently qualified to prepare this volume from their rich experiences and studies in family farming and land tenure.

The major purpose of the book, as stated by the authors, is to demonstrate how town and country churches, made up predominately of rural people, "can best shoulder their responsibility in strengthening the American system of family farming." The book is directed primarily toward workers in rural churches, the administraters, the ministers and the laity. The book also enlists the cooperation of workers in agricultural research and education, of members of farm organizations and of other rural leaders in developing programs to strengthen the family farm.

The general nature of tenure problems confronting family farmers is outlined. Experiences with various programs aimed at strengthening family farms are summarized. Finally, the manner in which rural churches may participate in formulating family farm policies and programs is suggested.

The book, organized into six chapters, treats goals of family farming, problems facing family farmers, needed improvements in family farm tenure, churches' endeavors to improve family farming, and proposed unified program for family farmers.

In attempting to articulate the Christian concept of family farming, the authors develop nine criteria for appraising family farming. Farming is characterized as a way of life as well as a means for earning a living. Management is vested primarily in the family that lives on and operates the farm. This family also contributes most of the labor. Such a farm will fully employ, in an efficient manner, from one up to two or three adult men and provide the family with an adequate living. Opportunity to develop human resources will be present as well as the incentives to conserve the soil and to use capital resources efficiently.

Problems facing family farmers are characterized in terms of getting established in farming, inheritance processes, leasing, labor conditions and credit arrangements.

Needed improvements proposed in terms of "three pillars of support" are increasing farm-home ownership, improving leasing arrangements and helping croppers and laborers up the agricultural ladder.

The volume is an excellent source book, in brief, for the interested layman to study as a prerequisite to entering into discussion and to supporting action concerning family farming. A study guide prepared by E. J. Neiderfrank accompanies the book and appears to be a well developed implement for discussing and understanding the volume by rural groups.

The weak features of the volume are few in light of the stated objectives. Possibly the volume could have benefited from the application of

more economic principles to size of farm, farm leasing, land valuation, credit and other matters discussed. Also, there appears to be some confusion surrounding the concepts of the operating unit and the ownership unit. At times, the family farm appears to be treated in terms of an operating unit that may be either rented or owned. At other times, ownership of the land resources appears to be a joint goal.

Aside from these shortcomings, the book should serve a valuable purpose in stimulating rural people to discuss farm problems through the effective medium of their churches. Also, basic data and ideas are presented to make these discussions more objective, better informed and more meaningful.

JOHN F. TIMMONS

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Economic and Technical Analysis of Fertilizer Innovations and Resource Use. Edited by E. L. Baum, Earl O. Heady, John T. Pesek, and Clifford G. Hildreth. Ames: The Iowa State College Press, 1957. Pp. xx, 393. $4.50.

This book is the second of a series, following one entitled *Methodological Procedures in the Economic Analysis of Fertilizer Use Data* which was published in 1956. This book includes papers presented at a seminar sponsored by the Tennessee Valley Authority at Knoxville, Tennessee, on March 27-30, 1956. Incidentally, this was the fourth conference sponsored by TVA since 1953 on the general subject of the economics of fertilizer. The editors state that the objectives "of the seminar and the book are to examine the most recent thought and research findings on the many aspects of fertilizer in the American economy, and to present new methodological techniques that will enable the more efficient handling of difficult research problems related to fertilizer, and at the same time secure more meaningful answers for practical application."

The reader will find that the range of subject matter presented is broader than might be deduced from the title, or even from the stated objectives. The selections cover the gamut from soil chemistry relative to fertilizer and economic aspects of alternative types of fertilizers to fertilizer research methodology and linear programming and, finally, to considerations of agricultural policy.

After an introduction by Leland G. Allbaugh, Director, Division of Agricultural Relations, Tennessee Valley Authority, the book is divided into five parts. Part I, entitled "Physical and Economic Aspects of Water Solubility in Fertilizer" consists of four papers on the chemistry of water solubility of fertilizers, on the economic importance of water solubility, on the technical and economic factors in the production of highly water-

soluble P_2O_5 fertilizer, and on crop response in relation to granulation and water solubility. Part II, "An Examination of Liquid Fertilizer and Related Marketing Problems," includes six papers covering the evaluation of liquid fertilizer, the economics of their manufacture, programming of fertilizer mixing operation, the potential market for liquid fertilizer, alternative methods of application, and the study of attitudes in fertilizer marketing. Part III is entitled "Methodological Procedures in the Study of Agronomic and Economic Efficiency in Rates of Application, Nutrient Ratios, and Farm Use of Fertilizer." It includes reports of experimental estimation of fertilizer response surfaces in North Carolina and Iowa. Also included are several papers on various statistical problems, as well as papers on the problem of joint agronomic-economic research. Part IV is devoted to "Farm Planning Procedures for Optimum Resource Use." It includes five papers reporting on various applications of linear programming techniques and a discussion of the nature of management. Finally, Part V is devoted to "Agricultural Policy Implication of Technological Change." This includes a paper by Schultz on supply response in agriculture, papers by Heady and Glenn Johnson on the contributions of production economics to agricultural policy, and a discussion of the low-income problem.

This book is not one to be read at one sitting. Rather, the typical reader will probably choose topics of particular appeal to his own interests. Thus parts I and II will probably be of particular interest to persons in the fertilizer trade and to farm managers. Some of the material in Part III is quite technical and is directed at statisticians and production economists, as well as to graduate students in agricultural economics. Parts IV and V will appeal to production economists and students.

Certain impressions of the various discussions can be noted. In part I, the economics of water solubility in phosphorous fertilizer, discussed by Pesek, Webb, and Terman, introduces some new refinements into the economics of fertilizer. Interesting also was the analysis by Hignett concerning the economics of producing P_2O_5 fertilizer of different levels of water solubility.

Similarly Part II illustrates the dynamic nature of the fertilizer industry and fertilizer use on farms at the present time with attention to liquid fertilizers. To be noted here is the thorough analysis of alternative methods of nitrogen application made by Heady and Baum in Iowa. A somewhat diffuse termination of this part, however, is the discussion of marketing attitude studies by Nybroten.

In introducing Part III, Heady and Baum develop the economic nature of fertilizer as a resource in the agricultural economy. Some readers will raise their eyebrows on philosophical grounds to the expression "the un-

raveling of the production function and the march of the supply function" (p. 129). Introduced in this paper is some of the variation in the ideas concerning research on production functions which later becomes evident between Schultz on the one hand and Heady and Johnson on the other. In later chapters (12, 27, 28, and 29) Schultz argues for a new theory of output growth. Heady and Johnson suggest rather a need for more micro- and macro-production economics analysis as a basis for policy adjustments.

Chapters 13, 14 and 18 present the results of and methodological problems associated with fertilizer response research in North Carolina and Iowa. Hildreth, in Chapter 16, comments appropriately on the problems of weather and soil conditions as related to fertilizer response, and goes on to develop models that include these variables in rather original fashion. Similarly, Anderson's paper on statistical problems (Chapter 17) will be worthwhile to persons interested in the design of fertilizer research. After reading the rest of the material in Part III, Chapter 20 by Robertson, Johnson and Davis on fertilizer research methodology is somewhat repetitious and elementary.

Hildreth in interesting fashion again in Chapter 21 gives some additional insights into linear programming problems. Johnson's discussion on the role of management has appeared previously in his book (*Farm Management Analysis* by Bradford and Johnson) as well as in a bulletin by Johnson and Haver. In Chapter 23 Heady and Baum give a useful comparison of programming and budgeting. The programming illustrations in chapters 24 and 25 are typical of those in the literature. Glenn Johnson's discussion of "overlooked considerations" in micro analysis in Chapter 29 is stimulating and helpful. In these later sections one becomes aware that the focus has left fertilizer and is now directed at analysis of resource use in general.

As one scans this book he cannot help being impressed with the tremendous amount of fertilizer research activity that the TVA has stimulated in recent years.

The book is not particularly well integrated. This is not the fault of the editors, but is due simply to the range of subject matter in the seminar. However, it contains some new ideas, techniques, and results of research. Agricultural economists involved in research will wish to see it.

HOWARD W. OTTOSON

University of Nebraska

Experiment in Extension: The Gaon Sathi, J. B. Chitambar, T. A. Koshy, A. T. Mosher, Evelyn Wood, and John Bathgate. Bombay: Oxford University Press, 1956. Pp. xv, 240. Rupees 7.

Although this book emphasizes procedure somewhat more than theoretical framework, it centers on what many economists believe is the key to national economic development—the extension system. There is a great need for up-to-date material regarding the theory and operation of the extension system within the individual environments of under-developed countries. The environment, in this case, is India and an ambitious Five-Year-Plan in which success depends heavily on the effectiveness of a new and growing National Extension Service.

A textbook is needed for use in the training of Indian extension workers. Moreover, India's young people, almost all of whom are highly intent upon the uplift of their nation, need a straight-forward description of the joy and the personal satisfaction as well as the trial and sacrifice that is a part of extension work. All of these varied needs should find themselves well served by this stimulating, highly informative, and well-illustrated book.

The authors are indeed well qualified to prepare such a text, inasmuch as they have been closely associated with Allahabad Agricultural Institute's Pilot Extension Project since its inception in 1952. The major part of their work has entailed training people for extension, either as village-level workers or as administrators. In the introduction the authors have pointed out that this is the first textbook that has grown out of actual extension experiences in India and, consequently, it represents only a starting point. They frankly admit, furthermore, that since they are still experimenting with new ideas and methods their statements are "tentative and suggestive, rather than conclusive." Finally, the authors grant freely that their conception of Indian extension, since it is based almost entirely upon experiences at Allahabad, may not be as applicable in certain other parts of the country where different customs, attitudes, and community organization prevail.

The book consists of eight chapters organized in two major groups. The first four chapters are devoted to a discussion of the background and present-day need for extension in India along with the authors' current feelings as to its purpose and what it can and cannot be expected to accomplish. The remaining chapters are primarily concerned with describing the function of the extension worker, the qualifications necessary for becoming an extension worker, and the kind of attitude necessary for effective extension work. In addition, one entire chapter is given to a discussion of a wide variety of teaching methods and to the types of situations in which each has been found most successful.

The authors' conclusion is, in general, that the Indian National Extension Service must be expanded and perfected as rapidly as possible, for it represents a real means toward closing the gap that presently separates India and the more advanced nations of the world.

There is little with which the reviewer would argue in this book, for the authors have been careful not to insist that the results of their experiments are universally applicable. Nevertheless, they have made many keen observations regarding the training of able extension workers. The frequent discussions relating experiences at the Allahabad project to ordinary patterns of human behavior are extremely interesting and, on the other hand, show clearly that the authors possess an intimate knowledge and a true appreciation of Indian village life.

Prospective extension workers are sure to find this book both readable and inspiring. It should also be of considerable interest to all who are concerned with national economic development.

DONALD NOVOTNY

Foreign Agricultural Service

Agricultural Cooperation, (Selected Readings), edited by Martin A. Abrahamsen and Claud L. Scroggs. Minneapolis: University of Minnesota Press, 1957. Pp. 576, $7.50.

Thousands upon thousands of pages have been written on the subject of cooperation in agriculture, but the available material is extremely scattered and it is highly varied in terms of level of write-up, philosophical framework, and objectivity. In answer to this problem the editors of *Agricultural Cooperation* have compiled into one volume 54 articles by 49 authors. The book lists among its authors many of the profession's prominent names.

As the reviewer thumbed through the book he asked, "Can half-a-hundred authors possibly write a coherent volume?" The answer is probably "no," but the editors have severely revised and condensed the articles. The volume *is* coherent. The material "flows" smoothly and the book is very readable.

The preface of *Agricultural Cooperation* states that it is a "systematic selection of materials" covering "the more important developments in agricultural cooperation." The need for a compilation of suitable materials has long been recognized and is accepted by the reviewer as a laudable objective. Therefore, the appraisal of the book is based upon the question: "Have the really important materials been compiled?"

The editors have attempted to give some attention to most aspects of cooperation. The reviewer agrees that all the issues covered are important, but cooperation is a very complex subject. We are like blind men "looking" at an elephant, each "seeing" from the vantage point of his own value system, training, and background. Theologians, sociologists, teachers, political scientists, competing businessmen, coop managers, farmers, consumers, and economists all view the development of cooperative activity differently. Many readers will wish that greater stress had been

placed on certain points, but even the more condensed viewpoints are covered well enough to provide a background for more intensive individual study. This is a mammoth achievement for so complex a subject.

The first of three major parts is entitled "The Emergence of the Cooperative Institution." Two approaches are used: (1) a sympathetic historical review and (2) a discussion diverging from the basic motivating forces behind cooperative development. These two approaches reappear throughout the book with history usually appearing first. Some history is necessary for an adequate understanding of cooperation, and the historical treatment is satisfactory.

Some college teachers may want to start their students on Chapter 2. Chapters 2-4 deal with the objectives of cooperation, giving consideration to the sociological, spiritual, and philosophical as well as the economic. These chapters do an excellent job of revealing variations in viewpoint about what is "important" in cooperation. However, space limitations have necessitated sketchy treatment of some points.

The organization of the book is good in that it builds "block upon block." Chapters 5-6 logically procede to economic theory and the so-called *principles of cooperation.* The economist will recognize that Chapters 4-6 build the philosophical and theoretical foundation upon which is based the selection of materials for the entire book.

Through the years cooperative philosophy, objectives, and principles have changed in keeping with the economic environment of the day. *Agricultural Cooperation* is in keeping with our current environment. Cooperatives are accepted as primarily economic agencies stressing business efficiency and bargaining power. The book presents our current "modal" viewpoint very well.

Part II is entitled "Cooperation in the Modern Economy" and is a "conducted tour" of the roles played by cooperatives in a commercial agricultural economy. Leaders from among the cooperatives should find the chapter entitled "Cooperatives and Other Business" a welcome source of answers to many of their critics' queries. Considerable attention is given to the potential contribution cooperatives can make toward an integrated agricultural business system. Since integration is a "hot" issue in agriculture today the reader should find chapters 11-12 very helpful.

Part III is an "Evaluation and Appraisal" of the role cooperatives currently play in the economy, with just a little crystal gazing to the future. The introductory chapter takes the reader back a step to review the "place of the cooperative institution." In chapters 14-16 no punches are pulled in establishing the fact the coops are not perfectly operated. The editors are to be congratulated for avoiding the easy and frequently unapplicable "how to do it" approach. The articles are hard hitting and lay

bare the "cracks" in the foundations of our cooperatives. Coop management, both lay and professional, needs to thoroughly understand the significance of what is said.

In summary, *Agricultural Cooperation* fulfills a need that teachers of cooperative classes have faced. The reviewer accepts almost all of the logic employed by the various authors. The treatment may be a little too sympathetic, however, for optimum college-level use. This is not a serious problem because the instructor can give critics of cooperatives more attention by extra reading assignments.

The organization of the book, the topics considered, the brevity of the articles, and the level of write-up make it ideal for use by county extension agents and vo-ag teachers. Every extension and vo-ag office should have a file copy. *Agricultural Cooperation* is an excellent source of "ammunition" for leaders in the cooperative field. Their cause is objectively presented. Cooperatives should consider presenting each newly elected member of the board of directors with a copy. Reading the book should lead to a quicker understanding of the cooperative institution's "place" in the economy and to a more thorough understanding of its problems.

JOHN L. FISCHER

University of Nevada

Financing Goods, Albert G. Sweetser. 160 Lincoln St., Newton Highlands, Massachusetts: A. G. Sweetser, 1957. Pp. xiv, 609. Trade list $8.00; college textbook list $6.00; library, bookstore, or professional net $5.00.

The author presents this work as "an introductory, one-semester textbook in business finance, designed to show the function of finance in basic business operations—marketing and production—and in basic business transactions—sales and loans."

The scope of the book covers three general areas: "(1) types of business operations (from merchandising to manufacturing to production of basic commodities including farming); (2) sources of capital (owners, sponsors, suppliers, customers, commercial banks, commission merchants, sales-finance companies, and warehousemen); and (3) legal relationships, instruments, and procedures (sales, consignments, unsecured promissory notes, liens, pledges, collateral notes, endorsements, subordination agreements, guaranties, warehouse receipts, real estate mortgages, chattel mortgages, and trust receipts)."

According to the author, the text has been prepared in a form that requires no previous study in the fields of business or economics. The student is expected to gain from the text a background in the essentials of business finance and bank lending preparatory to further study in administrative policy, economic theory, and government controls.

The work largely attains the objectives as outlined by the author.

A particularly helpful aspect is the extensive use of illustrative forms drawn from many sources, which are tied in closely with the text presentation. Any student who goes through it will have received a basic understanding of many important procedures and documents used in the financing of goods.

The agricultural economist will no doubt be of the opinion that the coverage of the text has limitations from his point of view. Although somewhat limited references are made to agricultural production financing and the warehousing and handling of agricultural products, primary emphasis of the work is placed on manufactured products.

The reviewer is of the opinion that in a text of this nature reference should have been made to some types of organizations and sources of financing that have not been included. For example, the discussion on page 6, categorically states that there are two types of wholesalers. The discussion contains no reference to the highly important cooperative wholesales, owned by retailers, such as those in the grocery trade.

Other important financing activities in the reviewer's opinion should have been cited in order to give a more rounded presentation. Examples include agricultural financing through the cooperative institutions of the Farm Credit Administration, more particularly the production credit associations, the intermediate credit banks and the banks for cooperatives. The activities of the federal government in the commodity lending field are covered only by a general reference. Farmers through their cooperative organizations are engaged in many significant operations in the field of goods financing.

The reservations of the reviewer, as illustrated briefly above, are not to be taken as indicating that the book is not a valuable contribution to an understanding of the financing procedures presented in it. Because of dominant use of financing through commercial banks for illustrative purposes, to the exclusion of other mechanisms, the initial introduction of the student to the field is not as well-rounded as might be desired, particularly from the agricultural-financing point of view. The book does present a wide field of valuable information to students of agricultural financing, not only for beginners but also for more advanced workers.

KELSEY B. GARDNER

Farmer Cooperative Service

Elementary Business and Economic Statistics, Alva M. Tuttle. New York: McGraw-Hill Book Company, 1957. Pp. xiii, 663.

This is a large book and apparently in reasonable accord with the scale of most books written in the field of elementary business statistics. After initially defining the subject of statistics to include two parts,

namely, descriptive and analytic, the author presents techniques of tabular and graphic presentation of data. This segment (except for a chapter on ratios and significant digits) comprises about one-third of the book.

The section of the book on statistical inference is introduced by a descriptive discussion of frequency distributions. A "cook-book" consideration of estimation and testing hypotheses about one or two population means follows. Later, after a chapter on index numbers (which seems out of place), a descriptive presentation of correlation analysis is given with an abbreviated discussion of its inferential aspects from the probabilistic point of view. Finally, the text ends with a lengthy discussion of analysis of time series.

From the organizational point of view, the section on "Ratios, Percentages, and the Rounding of Numbers" should have been placed in the appendix. Also, the section on index numbers could have been more appropriately positioned just preceding the discussion of time series.

Tuttle's chapter on index numbers is probably the best in the book. The sections on tabular and graphic presentation of data are also well done, but would be improved by eliminating redundant repetition. Appendix sections on sources of data and the bibliography are worthwhile. The utility of tables on logarithms, squares, roots, reciprocals, and random digits is not clear for a text of this type.

The itemized comments that follow are directed at most of the available books on elementary economic statistics as well as at Tuttle's volume:

1. The excessive repetition of specific points should occur in the classroom and not in the text. Conceptually, the basic considerations are not sufficiently difficult to warrant extended discussion.
2. Most authors give a confusing presentation of the analytic areas of estimation, hypothesis testing, and correlation or regression theory. The basic reason for this situation is the failure to clearly differentiate between discussions that are purely descriptive for specific data (a restricted population concept) and discussions relating to a probability model for sample data. Invariably the two become mixed and misleading statements are made because of no evidence to support which viewpoint is relevant.
3. Errors in presenting technical points occur even when the author apparently understands the basic principles involved. A good example occurs on page 298 of Tuttle's book in connection with the concept of interval estimation of the mean of a population. The two or three "half-correct" sentences could have been correctly stated by merely having a confidence interval "cover" and not a universe mean "lie." The verb should have accompanied the statistic not the parameter in order to indicate the random variable.

4. In writing about the association between two (or more) variables, an area of confusion is created by not carefully separating the mathematical relationship from the statistical definition of the correlation coefficient. This becomes apparent in discussions of nonlinear mathematical relationships. If the correlation coefficient were presented in terms of the linear association between Y and Y′, some of this confusion would be eliminated. Differences between correlation and regression analyses are not clearly stated.
5. The mechanical consideration of time series is given exaggerated significance. Failure to stress and stress again the naive, simple model as a function of time is a basic fault. Fleeting remarks alluding to more complex, analytic methods are not sufficient.

JAMES B. HASSLER

University of Nebraska

Regional Income, National Bureau of Economic Research, Conference on Research in Income and Wealth, Volume 21, Princeton, Princeton University Press, 1957, pp. x, 408, $8.00.

Regional Income represents the latest addition to the distinguished series of conference procedings issued by the Conference on Research in Income and Wealth and sponsored by the National Bureau of Economic Research.

The ten major papers presented at the conference, held at Duke University in the summer of 1955, can be classified under three major headings.

1. Three papers by Isard, Perloff, and Ulhman and Klove deal with *the "region" as a framework for economic analysis.* Isard's paper presents a plea for a stronger regional focus in economic analysis. He discusses the usefulness of such an emphasis to the solution of problems in the area of resource utilization, business cycle analysis, monetary and fiscal policy and economic growth. Perloff discusses the data requirements and limitations, as well as the conceptual problems, involved in assessing regional economic progress. Ulhman and Klove of the Census Bureau discuss research efforts by the federal statistical reporting agencies, particularly the Department of Commerce, to develop criteria for the regional aggregation of economic and social data.

These three papers represent an excellent introduction to a growing field of economic literature generally identified under the heading of "regional economics." It is interesting to observe that in spite of the relatively high proportion of agricultural economists who are working on problems that have a regional focus, agricultural economics literature has been singularly barren of any discussion of the conceptual aspects of "regional" and "locational" analysis with the minor exception of the

work that went into the development of type of farming area classifications. One might have expected that the proliferation of regional research committees and the growing interest in inter-regional competition would have given rise to greater interest in methodological issues related to the analysis of the spatial aspects of economic problems.

2. Five papers by Hochwald, Thompson, Fulmer, Shryock, and Hurwitz and Stallings deal with the *problems and techniques of developing social and economic accounts for small areas.* A major issue in this discussion is whether "short-cut" methods of estimating small areas' income payments can be made sufficiently accurate to replace the more detailed methods based on allocation procedures. In spite of Fulmer's vigorous dissent in favor of regression techniques, the general conclusion seems to be a rejection of the "short-cut" methods on the basis of lack of sensitivity to short-run economic changes. Indeed, one cannot but be impressed by the high degree of "art" involved in successful construction of income estimates for small areas, in spite of the effort such agencies as the Federal Reserve Bank of St. Louis and the Conference on Measurement of County Income (of the Southeastern Bureaus of Business Research) have devoted to methodological problems.

The paper by Hurwitz and Stallings is of special interest. It represents the most complete attempt with which I am familiar to present regional and state consumer price indexes. The state and regional consumer price indexes for urban areas appear to be rather soundly based. Lack of sufficient regional and state data on prices paid by farmers (or for the rural population as a whole) made it impossible to construct regional indexes of prices paid by farmers or by the rural population, thus limiting the accuracy of the total index.

3. The two papers by Hanna and Mansfield represent major pieces of *empirical research on the factors affecting income differentials among states and regions.* These two papers, together, represent the most complete report yet available on the Duke University "Study of Differences in State per Capita Incomes" sponsored by the Rockefeller Foundation.

The effect of Mansfield's paper is to cast some doubt on the importance of the assumption of a positive relationship between city size and personal income.

In spite of apparent disagreement between Mansfield and Johnson regarding Johnson's thesis that the incomes of White nonfarm families living in the South are approximately the same as the incomes of White nonfarm families living in the rest of the country when incomes are adjusted for city size, one comes away with the feeling that neither Johnson nor Mansfield fully come to grips with the other's argument.

The major conceptual arguments centered around (1) Hanna's general hypothesis, that from an economic standpoint states have no economic

significance of themselves but merely represent one of a number of randomly selected sets of subareas, the differences in per capita incomes among states arising from the varying combinations of skills, industries, and resources found in the several states, and (2) the method Hanna employs in arriving at his conclusion that variations in occupational composition alone account for 80 percent of the variation in state per capita income payments.

Hanna's conceptual approach to regional analysis, which places no emphasis at all on the region as an organic unit and relegates location to a secondary system of classification, is in direct opposition to the approach taken by the authors of the first group of papers discussed. To Isard, the region is a metaphysical entity made up of hierarchical array of interrelated subregions. He objects strongly to "mere cataloging, processing, and analyses of data by standard . . . geographic divisions" (p. 69).

To my mind the two approaches are not as different as they seem to appear to Hanna and to Isard. Isard is concerned with explaining why a particular complex of economic activity develops in a particular location. Hanna is concerned with explaining how the particular distribution of economic activity among industries affects the level of community income. Both approaches are valid when applied in relation to the appropriate questions.

VERNON W. RUTTAN

Purdue University

The Response to Industrialism, 1885-1914, Samuel P. Hays. Chicago: The University of Chicago Press, 1957. Pp. ix, 210. $3.50.

"This period, the Populist-Progressive Era, is one of the richest in American history," says Samuel P. Hays of the years covered by his study, "for here one can observe changes in the experience and behavior of people under the impact of the most profound influence in the modern world." This is, without doubt, a most challenging statement. Yet, this reviewer finds that Hays is well armed and ready for major combat.

In this interpretive history, the author has in a stimulating manner analyzed the economic, social and political transformation of the United States from the days of Reconstruction to the Wilsonian era. It is not simply a series of dates and happenings. Here is a story relating the "growing pains" of an economic system in the transition of development from a primarily agricultural state to a highly industrialized economy. Hays did not attempt to write a detailed history of this period. Instead he limited his analysis to what he considered to be the more significant forces shaping human behavior during this time. He has skillfully woven this period into the course of economic development in the United States

and treats the period as a unified part of this development.

The organization of his study is good. He begins with a discussion of the changes that occurred and how they affected the individual. The oft-cited cold impersonal relationship between business and labor is discussed. The worker no longer found himself a master of production; he was simply a link in the production chain. The workers' feeling of the need for organization to secure bargaining power became clearer and clearer. This was, in large part, a materialistic world and one in which every individual must do his utmost to enhance his personal interest.

The problems associated with urbanization are brought to light. This is particularly true in relation to the problem of assimilating the mass of immigrants pouring into the country during this period. The antagonism on the part of the "natives" to these "usurpers" is vividly portrayed. The graft and corruption found in city development is also all a part of this adjustment. The rural-urban conflict is discussed in some detail along with an examination of the clamor for rural development programs and associations. One is reminded of the similarity of present agricultural problems.

The geographical disturbances are noted. The "New South" and the rapidly developing West, both in the throes of colonialism, are most bitter to the Northeast. The Granger and Populist movements, the Farmers Alliance, and the "scientific tariffs" are important expressions of human adjustment in the mind of Hays.

Lastly the violent political upheavals are placed in perspective. These were the days of the "cross-of-gold" Bryan, "Uncle Joe" Cannon, "Teddy" Roosevelt, LaFollette, Taft and Wilson. At the end of this period the United States stood, with rather unsteady feet, at the brink of being the world's greatest power.

Hays' general conclusion is that "industrialism was less important in changing the motives of Americans than in profoundly altering the environment, the setting within which men and women strove for many different goals." He does not agree with many historians who point to this era as a period of revolt against corporations. He looks upon it in a much broader sense as being a period of human adjustment to the impact of technology.

To the reader who is interested in getting a thumbnail sketch of this period this book is lively and recommended reading. For the more inquisitive and searching reader an excellent suggested reading list has been included.

HELMER HOLJE

Montana State College

Atomic Energy Applications with Reference to Underdeveloped Countries, B. C. Netschert and S. H. Schurr. Baltimore: The Johns Hopkins Press, 1957. Pp. xiv, 129. $2.00.

The number of areas in which research on applications of atomic energy is being carried on is striking. Perhaps as striking is how unready we are to apply conventional economic analysis to the problems of decision making concerning atomic energy. Constant reference in this survey to "the as yet unknown economies of . . ." drives home this point. As a result, the major contribution of this survey may lie with the dual role of clarifying, through a comprehensive survey of work in progress, how uncertain the present situation is concerning atomic energy and yet how real atomic energy considerations must be in present day planning of long-term capital expenditure programs. The thought that a few years delay on a capital expenditure program might allow time for development of a considerably more advanced technology must surely be unsettling to present-day planners. The importance of conserving scarce capital resources and the usual difficulties of making cost-benefit comparisons serve as magnifiers of this problem.

The authors are explicit in stating that they are presenting a preliminary survey, and one that "raises more questions than it answers." The pace of development in this field is indicated by the careful footnoting of the phrase "present status" with a January 1957 date—present clearly refers to a single point in a rapidly evolving continuum.

The survey is comprised of three parts. The first deals with the range of potential applications of atomic energy with division of consideration into those involving nuclear reactors, requiring capital outlays of up to $100 million, and those using non-reactor radiation. Part two deals with "the necessary conditions for using nuclear energy." This attempts to deal with both the technical and economic feasibility of various applications. The last part of the study provides an excellent survey of the surprisingly large number of international activities in nuclear energy and development. Consideration is given to both US governmental and non-governmental activities as well as those of the UN and other international and regional agencies.

The title of this publication serves as a source of some disappointment to one interested in economic development. This survey does not provide a specific direction of the attention to atomic energy applications to underdeveloped countries. It is rather a comprehensive discussion of potential applications including some incidental comment relevant to problems of underdeveloped countries. If the purpose was that implied in the title, a delineation of the peculiar needs of underdeveloped countries and a redistribution of emphasis toward the most relevant applications would have been useful.

There remains much of relevance in the survey to one interested in economic development. Of most obvious import are the long-term implications of atomic energy to capital-output ratios. Countries with a high proportion of their population in agriculture and experiencing rapid rates of population growth are clearly concerned with the degree to which capital formation rates will be sufficient to absorb growth in population and eventually allow reduction in the absolute numbers in agriculture. The development of atomic energy power sources could conceivably reduce the capital requirements for power generation and leave more capital available for creation of jobs in complementary industries. Although some figures on capital cost are presented, too little has yet been done in the field of commercial nuclear power production to be able to say much about this potential. It is not yet known for example which of many possible reactor designs will prove most economical under various conditions, let alone how the costs of these compare with conventional sources. Even greater uncertainty is associated with the competitive potential of small-scale nuclear power plants, with an estimated minimum of ten years before such plants are sufficiently developed and tested to be made available for general use.

Important as is the capital problem in the process of economic development, economists are coming more and more to recognize such problems of "absorbtive capacity" for capital as the availability of trained or readily trainable manpower for technical tasks. The authors' discussion of manpower requirements for atomic energy development is useful but appears more closely pitched to the problems of developed than to underdeveloped countries. It is indicated that substantial numbers of highly trained personnel are needed for nuclear power operations, but the point is made that there is reason to expect that in this, as with past technological developments, the work will eventually be reduced to more easily routinized component parts. The point that needs fuller exploration for the case of underdeveloped countries is the degree to which supporting personnel of only moderate technical competence are available for such time as the need for the most highly trained workers diminishes.

Among specific applications, the survey touches on the potential for radiation fixation of atmospheric nitrogen as one of "immense potential significance to underdeveloped countries." Here again the technical coefficients for cost studies are either not available or so subject to change as to be irrelevant. It is suggested, however, that a dual purpose power-radiation reactor could be developed for this purpose. The implications of a low-cost source of nitrogen for the underdeveloped countries, so many of which are dominated by highly leached tropical soils, are immense.

Less spectacular and more traditional, but perhaps of more immediate

importance, are the many uses of radiation in agriculture for food preservation, pest control, genetic development and physiological research. These atomic energy applications are comprehensively surveyed. The satirist could easily belittle the importance of this work by quoting "the most spectacular application of atomic energy in this field is the eradication of the screw-worm from the island of Curaçao by means of Cobalt 60 irradiation of male flies reared in captivity" and the subsequent lack of progeny from the females with which these males mated. Nonetheless, this and similar applications have been important.

The survey is perhaps overly naive in suggesting what can be done, but the potential for speeding the development of new breeds and varieties of plants and animals to better suit the conditions of underdeveloped countries is still substantial. Again, the fact that many underdeveloped countries have soils and climates quite different to those for which the bulk of past agricultural research has been carried on lends importance to any device which will speed the research process and conserve technically trained manpower.

Even though analytical study of an economic nature may be premature due to the undeveloped state and rapidity of technological change in the atomic energy field, a useful function has been served in making our ignorance so specific and at the same time warning of the areas in which development is most imminent and in which cost analysis will soon be necessary and possible. The reader with a clear (*sic*) picture of the economic problems of the underdeveloped countries and who wishes a review of development in the atomic energy field which he may fit into such a frame of reference will find this survey a useful, time-saving compilation.

JOHN W. MELLOR

Cornell University

A Concept of Agribusiness, John H. Davis and Ray A. Goldberg. Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1957. Pp. xiv, 136. $6.00.

In December 1952, the Harvard Business School formally launched a program in agriculture and business, the purpose of which was to "conduct studies of agricultural and industrial relationships. . . ." This publication is the first fruit of research conducted under the program. It explores the "farm problem" in a new and broader perspective by development of a new concept, "agribusiness," and appraisal of the extent and amount of agribusiness interrelationships, using the Leontief input-output system of economic analysis.

The book contains an introduction, four chapters of text, and an ap-

pendix. The chapters cover the "Evolution of Agribusiness" the "Nature of Agribusiness," "Analysis of Agribusiness," and the "Implication of the Agribusiness Concept."

The appendices are (1) a glossary of terms used in the report; (2) numerous tabular summaries; and (3) supplementary discussion of certain agribusiness relationships.

In 1800 agriculture, so-called, was a self-contained industry employing 80 percent of total American working force. Since then the actual functions performed by the farmer on his farm, "agriculture" if you will, have shrunk from a full line of service to the relatively simple single function of production of raw materials that must go through several off-farm steps before reaching the ultimate consumer. Since the segment of our national economy producing food and fiber is no longer self-sufficient, but is inextricably dependent on off-farm functions and forces, a new term, "agribusiness," is suggested. "Agribusiness" is "the sum total of all operations involved in the manufacture and distribution of farm supplies; production operations on the farm; and the storage, processing and distribution of farm commodities and items made from these. Thus, agribusiness essentially encompasses today the functions which the term agriculture denoted 150 years ago."

Viewing agribusiness quantitatively, the authors group the business firms and farm units of which it is constituted into three aggregates, farm supplies, farming, and processing-distribution, under the general title of "Primary Agribusiness Triaggregate."

Using several sources of data, and resorting to extrapolation or estimate as necessary reveals that in 1954 agribusiness accounted for about 40 per cent of consumer expenditures in that year, using plant, equipment and other assets worth 220 billion dollars.

Qualitatively, agribusiness is characterized by many firms and little vertical integration. The result has been an inability of agribusiness management to make a rational, unified adjustment of supply to demand. Government programs created to cope with the problem have proved a palliative, not a cure for chronic surpluses.

To analyze and illustrate the flow of goods and services within and between the segments composing agribusiness, and using 1947 data, the authors derive an agribusiness flow chart for 1947, tracing in graphic form the utilization of major farm supplies, items in farm production, and the "movement of the resultant farm commodities through successive stages of processing and distribution." A number of additional flow charts, tables and pie charts are also derived from the basic input-output chart to further illustrate and shed light on the movement of goods and services through the agribusiness economy. (A footnote explains that "the year

1947 was selected for this purpose because it is the most recent census year for which reasonably complete data were available.")

In their conclusion, the authors discuss the need for a national agribusiness, rather than a farm policy, on the grounds that the nation is faced with an agribusiness rather than a farm problem. It follows that "the approach to solutions must be as comprehensive as is the basis of the problems themselves." The task of this study has been, in part, to demonstrate just how comprehensive those bases are.

A Concept of Agribusiness presents a persuasive and provocative new perspective on causes of, and suggested solutions for, the "farm problem." Granting the validity of the basic premise, the problem would seem to be lack of integration in the broadest sense in management decision-making concerning agribusiness production and distribution. The solution then suggests itself—more effective integration of management decisions, through improved communication, in an agribusiness frame of reference, based on up-to-date knowledge.

In their discussion of the application of the agribusiness concept to the solution of current problems, the authors use the terms "policy" and "program" interchangeably. There is a school of thought which views a policy as a desired status or goal, relatively unchanging. A program then is a method or path leading to a desired goal. Care in making this distinction might have lent added precision and force to the authors' remarks on policy.

The development of a composite agribusiness balance sheet in this study makes possible some interesting ratio analysis. However, this type of analysis can be useful only if balance-sheet data are (1) accurate; and (2) up to date. A knowledge of a 26-percent drop in current ratio between 1947 and 1954 might be of purely academic value if not available until 1957. Similarly, data derived in part from extrapolation and proration of balance-sheet items on the basis of relative volumes could be subject to some error, as could any ratios derived therefrom.

The same comment can be made for the input-output chart, and the agribusiness flow chart and other tables stemming from it. The concept of agribusiness was developed to describe a current, dynamic situation, and input-output analysis applied to measure it in dynamic terms. Insofar as there is a lag between data-producing business activity and completion of analysis of that data, neither the concept nor the analysis will achieve optimum usefulness. At the time this book was written there was a substantial lag.

But, these comments have been made before. It is reasonable to assume that as the technique and the concept receive further attention these weaknesses will be overcome. Meanwhile, the concept of agribusiness

developed and analyzed by Dr. Davis and Dr. Goldberg provides a challenging and stimulating perspective. What will be done with it remains to be seen. It is to be hoped that we will hear from them soon and with greater depth on some of the implications of the information provided by *A Concept of Agribusiness.*

IRWIN W. RUST

Farmer Cooperative Service

A NOTE ON WILCOX'S REVIEW

J. K. GALBRAITH
Harvard University

IN THE August 1957 issue of this *Journal* Dr. Walter W. Wilcox, in his review of Benedict and Stine, *The Agricultural Commodity Programs: Two Decades of Experience,* has, I am sure unwittingly, left an erroneous impression of my review of the second volume in this series by Professor Benedict. Wilcox says, in effect, that the economic attitudes in this earlier volume were responsible, in my view, for reducing agricultural economists to the role of neglected scolds on matters of agricultural policy. Although I did disagree with Benedict in some particulars, I did not direct any such remark to his work. On the contrary, after carefully separating my review into two numbered parts, I directed this comment to the report of the committee which the Twentieth Century Fund, for reasons best known to itself, constituted to distill policy conclusions and other wisdom from Benedict's book. My admiration for this addendum was indeed circumscribed. But I regard Benedict's volumes as valuable contributions to the history of agricultural policy, and I should indeed be sorry if he or anyone else were led to think otherwise.

NEWS NOTES

FRED ANDERSON joined the staff of the Department of Agricultural Economics and Rural Sociology at the University of Arkansas October 1, 1957. He is completing the requirements for his Ph.D. degree at the University of Florida.

SIDNEY C. BELL has resigned as Instructor and Assistant in Agricultural Economics at the Alabama Polytechnic Institute to continue his graduate work at Michigan State University.

CALVIN R. BERRY rejoined the Department of Agricultural Economics and Rural Sociology at the University of Arkansas in September 1957. He had been at Purdue University since September 1955 where he is completing the requirements for his Ph.D. degree.

ROLAND C. BEVAN is acting head of the Department of Agricultural Economics at the University of Idaho while William E. Folz is on sabbatic leave.

C. E. BISHOP has accepted the position as Head of the Department of Agricultural Economics at North Carolina State College.

PAUL T. BLAIR, Assistant Professor of Agricultural Economics, Mississippi State College, began a leave of absence September 15, 1957 to complete requirements for the Ph.D. degree at the University of Florida.

DWIGHT BLOOD was selected as the recipient of the first Charles N. Shepardson Award at Colorado State University. The $500 award was established by Mr. and Mrs. Shepardson to encourage and promote excellence in teaching at this institution. He is currently on leave while working toward the Ph.D. degree at the University of Michigan.

HOWARD J. BONSER, formerly at the University of Tennessee, has joined the Extension Staff at Pennsylvania State University.

R. G. BRESSLER retired on July 1 from the Chairmanship of the Department of Agricultural Economics and the Directorship of the Giannini Foundation. He will be on sabbatic leave for one year and at the end of that time will return to the Department to devote full time to teaching and research. George L. Mehren replaced Bressler as Chairman and Director.

RAY T. BRITT has accepted an appointment at the University of Tennessee as Assistant Agricultural Economist.

W. N. CAPENER will join the staff of Colorado State University as Assistant Agricultural Economist upon completion of the Ph.D. requirements at the University of Illinois.

RUDOLPH CHRISTIANSEN has resigned from the Wisconsin State Department of Agriculture to work for the Northern Field Research Section, FERD, ARS at Madison, Wisconsin.

RONDO A. CHRISTENSEN completed the Ph.D. requirements at Cornell University and accepted an appointment at Utah State University beginning September 1. He will teach and do research in marketing.

BOYD A. CHUGG, a graduate of Utah State College, has joined the Washington staff of the Farm Economics Research Division, ARS. He was formerly employed by the Federated Milk Producers Association at Salt Lake City.

FRED CLARENBACH, Farm Economics Research Division, ARS, left recently for Ceylon on a one-year assignment for FAO to continue the work on land problems begun by Mark Regan.

CLIFTON B. COX, Professor of Agricultural Marketing at Purdue University, is on leave this academic year to work with John Davis and associates in the Graduate School of Business Administration at Harvard.

JOHN CRECINK, Farm Economics Research Division, ARS, is now stationed at State College, Mississippi, where he will work on a cooperative study of low income farms in the Clay Hills Area of Mississippi.

ROBERT D. DECKER has accepted a position effective September 1, 1957 as Assistant Professor in the Department of Range and Animal Husbandry, Sul Ross State College, Alpine, Texas. He expects to complete requirements for the Ph.D. degree in Agricultural Economics at Texas A. and M. College in January 1958.

R. A. EASTWOOD, formerly with the National Dairy Association, has accepted a position as Marketing Specialist in the Florida Agricultural Extension Service.

EBER ELDRIDGE has joined the staff of the Department of Economics and Sociology at Iowa State College as Extension Economist. He will work half time in the new program of the Agricultural Adjustment Center and continue his graduate work toward the Ph.D. degree.

K. ROBERT ELLINGER has joined the staff of the Department of Agricultural Economics, Ontario Agricultural College, Guelph. He will work with Dr. M. A. MacGregor on marketing research.

KENNETH R. FARRELL has joined the staff of the California Agricultural Extension Service at Berkeley. Prior to assuming his new duties as Extension Economist in marketing, he was Research Associate and Instructor at Iowa State College.

WALLACE T. FERRIER has retired as Agricultural Economist for the South Carolina Agricultural Experiment Station following 20 years' service in that state. He and Mrs. Ferrier will continue to make their home on the Clemson campus.

ROBERT N. FINLEY, formerly on the staff at the University of Illinois, joined the Department of Agricultural Economics at the University of Nebraska on August 1 with the rank of Assistant Professor. He will teach and do research work in the area of farm management and production economics.

W. L. FISHEL has joined the staff at North Carolina State College as an instructor.

WILLIAM E. FOLZ, head of the Department of Agricultural Economics at the University of Idaho, is spending a year of sabbatical leave beginning July 1, 1957, with the Agricultural Marketing Service in Washington, D.C. While on leave he will make a study of integration in marketing and its effect on farmers.

PHILLIPS FOSTER has been appointed Assistant Professor in extension (public policy) at Michigan State University. Mr. Foster has completed his graduate work at the University of Illinois and has studied both in India and Colombia.

GLEN FULCHER, who recently finished his preliminary examination for his Ph.D. degree at the University of Wisconsin, has taken a position at the University of Nevada as Assistant Professor in land economics.

THEODORE F. FULLER joined the staff of the Farm Economics Research Division, ARS, in July and is stationed at University Park, Pennsylvania. Mr. Fuller received his M.S. degree in geography from Pennsylvania State University.

B. D. GARDNER was appointed assistant professor of agricultural economics at Colorado State University on September 1. He will return to the University of Chicago during the summer of 1958 to complete requirements for the Ph.D. degree.

JAMES R. GIBBONS, formerly vocational agriculture instructor at Peru, Illinois, has been appointed an Instructor in Agricultural Economics at Iowa State College. He will teach introductory courses in farm management and will work toward the Ph.D. degree. Mr. Gibbons received his M.S. in Agricultural Economics from the University of Illinois in 1946.

JIMMIE J. GIGOUX has joined the staff of the Department of Agricultural Economics and Rural Sociology at the University of Arkansas as an instructor. He received his M.S. recently at Oklahoma State University, and will be doing research in the field of farm finance.

KENNETH GILBRAITH has joined the staff of the Farm Economics Research Division, ARS, and is stationed at Gainesville, Florida. Mr. Gilbraith received his B.S. and M.S. degrees from the University of Florida.

ROBERT L. GLOVER has resigned as Assistant in Agricultural Economics at the Alabama Polytechnic Institute to continue his graduate work at Vanderbilt University.

RICHARD J. GOODMAN has been appointed Research Fellow at the University of Minnesota. He was formerly an Instructor at North Dakota Agricultural College.

RONALD S. GRAYBEAL, formerly affiliated with Western Maryland College has been appointed a research intern for the academic years 1957-58 and 1958-59 at the Food Research Institute of Stanford University.

LEIGH H. HAMMOND, Assistant Professor, has been on leave from the Department of Agricultural Economics and Sociology, Texas A. and M. College to pursue study toward the Ph.D. degree at North Carolina State College since September 1, 1957.

JAMES B. HASSLER has resigned from the Department of Agricultural Economics, University of California, to accept a position at the University of Nebraska.

GLENN W. HEDLUND returned in August to his duties as Head of the Department of Agricultural Economics at Cornell University. He spent the preceding year as Visiting Professor at the College of Agriculture of the University of the Philippines.

KENZI HEMMI, research worker in the National Research Institute of Agriculture in the Japanese Ministry of Agriculture and Forestry, is at the Food Research Institute of Stanford University as a Rockefeller Fellow on a twelve-month appointment.

FRANCIS HIETT has resigned from the staff of the Farm Economics Research Division, ARS, to resume his teaching position at a junior high school in Alexandria, Virginia.

HOWARD HILL received his Ph.D. degree in June 1957 at the University of Wisconsin and is now employed in the Land and Water Section, FERD, ARS, at Washington, D.C.

DONALD E. HIRSCH resigned his position as Chief of the Dairy Branch of Farmer Cooperative Service, U. S. Department of Agriculture, to take a position as Assistant Director of the Commodity Division of the American Farm Bureau Federation, Chicago, Illinois.

EARL HODGES joined the Washington staff of the Farm Economics Research Division, ARS, in July. He will work on estimates of feed consumption and related analysis. For the last 10 years, Mr. Hodges, who holds degrees from Iowa State College and South Dakota State College, served as Business Manager and Professor of Sociology at Sioux Falls College, South Dakota.

ANDREW C. HUDSON has been appointed Assistant Professor of Agricultural Economics at Texas A. and M. College, effective September 1, 1957. He was formerly Research Assistant at Texas A. and M. College, where he has been working on a Ph.D. degree.

PRINT HUDSON, former Agricultural Attaché, American Embassy, Athens, Greece, has been transferred to the staff of the Assistant Administrator, Market Development and Programs, FAS, Washington. He will work in the coordination of Commodity Competition research activities of the Service. Upon his departure from Greece, Mr. Hudson was awarded an Honorary Professorship by the Board of Regents of the Superior College of Agriculture at Athens.

H. B. JAMES has resigned as Head of the Department of Agricultural Economics and has accepted the position of Director of Instruction for the School of Agriculture at North Carolina State College.

A. WILLIAM JASPER, formerly managing editor of *Poultry Tribune* and economist for Watt Publishing Company, resigned his position June 30, to accept a one-year appointment as Acting Associate Professor of Marketing at Cornell University. His time will be devoted mostly to extension poultry farm management and marketing, with some related research activities.

LINELY JUERS has accepted a position as Director of Dairy Research for the Wisconsin Council of Agriculture Cooperative, Madison, Wisconsin. He was formerly a Research Fellow at the University of Minnesota and received a Ph.D. degree from that institution in August.

GORDON A. KING resigned from the United States Department of Agriculture at Washington to accept a position with the University of California at Davis. He came to the Davis campus July 1, 1957.

L. B. KRISTJANSON finished his Ph.D. preliminary examination at the University of Wisconsin and has taken a position with the Extension Branch of the Manitoba Department of Agriculture, Winnipeg, Canada.

THEODORE LEED has accepted a position as Extension Professor in Agricultural Economics at the University of Massachusetts to become the management specialist in the Massachusetts marketing firm's team. Other specialists in the team will be a food engineer, a food technologist and a marketing economist.

Q. W. LINDSEY has returned to the staff at North Carolina State College after a year's leave of absence which he spent at Harvard University.

R. D. LLOYD has accepted a position with the FERD and is stationed at the University of Nevada. His research will be in ranch management and economic efficiency in the use of irrigation water. He has recently completed his Ph.D. classwork at Utah State.

BENJAMIN H. LUEBKE, formerly at the University of Tennessee, joined the staff at Berea College, Berea, Kentucky, on September 15.

JAMES R. MARTIN joined the staff of the Farm Economics Research Division, ARS, at College Station, Texas, effective July 1, 1957. He received his M.S. degree in June 1957 from Texas A. & M. College.

VERNON C. MCKEE has been appointed Instructor in Agricultural Economics at Kansas State College to assist in research and teaching in land economics.

HENSLEE C. MCLELLAN, JR. has joined the staff of the Department of Agricultural Economics and Rural Sociology at Clemson. He will devote full time to research.

W. K. MCPHERSON returned September 15 to his position of Professor of Agricultural Economics at the University of Florida after spending three months as Consultant in Land Economics in Costa Rica.

W. W. MCPHERSON has returned to the staff at North Carolina State College after an 18-month leave of absence during which time he served as advisor on agricultural economics to the Central Planning Board, Government of Pakistan, in the development of their first five-year plan for economic and social development.

LEO MORAN, after completing his Ph.D. degree at the University of Wisconsin, is now Assistant Professor of Farm Management at the University of Arizona.

V. L. MOTE, Associate Agricultural Economist, University of Florida, has been given leave to return to India because of illness in his family.

GEORGE MYLES has accepted a research and extension appointment in farm and ranch management. He just received his M.S. degree from Oklahoma State University.

WESLEY F. NICKLAS has joined the staff of the Special Crops Branch of Farmer Cooperative Service, U. S. Department of Agriculture. Prior to joining Farmer Cooperative Service he was employed by H. J. Heinz Company. He will work on marketing problems of rice and tobacco cooperatives.

PHILIP OLSEN joined the staff at Purdue University in September as Instructor to do teaching and research in Rural Sociology and Agricultural Economics.

HARRY T. OSHIMA, who has been at the Food Research Institute of Stanford University for the past year, has been appointed Assistant Professor in the Department of Economics of the University of Washington.

WYN F. OWEN, formerly at Wisconsin, has accepted an appointment as Associate Professor of Economics at the University of Colorado at Boulder, Colorado, where he will develop new course work in the economics of agriculture and primary resources as well as related teaching and research in the areas of economic development, international economics and methodology.

JERRY H. PADGETT, Assistant Agricultural Economist in Dairy Marketing Research, began his work on his Ph.D. degree at Purdue University September 1, 1957.

JOHN R. PARKS joined the staff of the Agricultural Experiment Station of the University of Alaska, in September, reporting for duty at Palmer, Alaska. Mr. Parks was formerly with the Kansas Extension Service as Assistant County Agricultural Agent in Pratt County.

VERNON PHERSON, Instructor in Agricultural Economics at Purdue, is on leave as a researcher this year to work with John Davis, C. B. Cox and associates in the Graduate School of Business Administration at Harvard University.

JEROLD F. PITTMAN has rejoined the staff of the Department of Agricultural Economics at Clemson after a year of study toward the Ph.D. at Pennsylvania State University.

JAMES T. RALPH joined the staff of the University of Kentucky in February as Assistant Professor, after completing graduate work at the Food Research Institute at Stanford University. He will do research in agricultural marketing.

MARK REGAN, Farm Economics Research Division, ARS, has returned from his assignment with the Food and Agriculture Organization in Ceylon, where he worked on land problems.

DONALD G. RICHARDS, formerly affiliated with the University of California and Harvard University, has been appointed a research intern for the academic years 1957-58 and 1958-59 at the Food Research Institute of Stanford University.

JOSEF RICHTER has been appointed Lecturer in the Department of Agricultural Economics, the University of British Columbia.

LACEY F. RICKEY of the Farm Supplies Branch of Farmer Cooperative Service has retired after 27 years of service with the U. S. Department of Agriculture.

N. KEITH ROBERTS joined the staff at Utah State University July 1 as Associate Agricultural Economist. Mr. Roberts was formerly at the University of Florida.

R. WAYNE ROBINSON, Assistant Professor of Agricultural Economics, has resigned as Marketing Information Specialist in the Kansas Extension Service to accept a similar position in the Extension Service of the University of Idaho.

ROBERT ROGERS returned to Washington recently after 2 years spent in graduate work at the University of Chicago. He has now completed the course work for the Ph.D. in Agricultural Economics.

MARGARET CLARE ROYCE, formerly affiliated with the Economics Division, FAO; and Cambridge University, has been appointed a research intern for the academic years 1957-58 and 1958-59 at the Food Research Institute of Stanford University.

FRANCIS M. SIMPSON, who five years ago retired from his position as Director of Research for Swift and Company and came to Clemson as visiting Professor in the Department of Agricultural Economics has now retired for the second time. At Clemson Mr. Simpson taught a course in Marketing Livestock and Meats and did considerable writing. He and Mrs. Simpson will continue to make their home at the Clemson House.

ELDON D. SMITH, formerly at the University of Tennessee, has joined the staff at the University of Kentucky.

STEPHEN HOWARD SOSNICK accepted a position with the Department of Agricultural Economics, University of California on the Davis campus. He reported to Davis on July 1, 1957.

DOUGLAS C. STRONG resumed his position at Utah State University August 1, having spent the past year at Michigan State University working toward the Ph.D. degree in Agricultural Economics.

GERHARD TINTNER is resuming his duties at Iowa State College after a year as Visiting Professor of Econometrics and Statistics at the University of Vienna under a grant from the Ford Foundation. During the year he has also presented papers and given lectures in France, Italy and West Germany.

ROBERT L. TONTZ, formerly Agricultural Economist with the Farm Economics Research Division, Agricultural Research Service, Washington, D.C., was appointed on June 30, Assistant Chief, Trade Statistics Branch of the Foreign Agricultural Service, U. S. Department of Agriculture, Washington, D.C.

ONNO VAN TEUTEM, formerly affiliated with the ECLA/FAO Joint Programme, Michigan State University and Oklahoma A & M College, has been appointed a research intern for the academic years 1957-58 and 1958-59 at the Food Research Institute of Stanford University.

DONALD L. WALKER has joined the Washington staff of the Farm Economics Research Division to work with the Western Field Research Section. His first assignment is in connection with evaluation of the conservation reserve program. Mr. Walker came to the Division from the University of Idaho where he recently completed the work for his M.S. degree.

J. J. WALLACE of the Department of Economics and Sociology at Iowa State College has been granted a leave of absence to accept an assignment in the Point Four program to help establish a commercial farm management service in Chile.

ARTHUR (TORCHY) WALRATH, completed his Ph.D. degree at the University of Wisconsin, has left the Northern Field Research Section, FERD, ARS, at Madison to work for the Southern Field Research Section at Virginia Polytechnic Institute, Blacksburg, Virginia.

ANNE WALSH, formerly affiliated with the Economics Division, FAO, and Oxford University, has been appointed a research intern for the academic years 1957-58 and 1958-59 at the Food Research Institute, Stanford University.

CLIFTON R. WHARTON, JR. has been appointed Executive Associate with the Council on Economic and Cultural Affairs, Inc. in New York.

ROGER H. WILKOWSKE has joined the Kansas Extension Service as Dairy Marketing Specialist. He is a graduate of Kansas State College with an M.S. degree from Michigan State University and a Ph.D. degree from Pennsylvania State University. He has served on the staff of the New York Milk Market Administrator.

F. W. WILLIAMS has accepted a position as Assistant Agricultural Economist in the Florida Agricultural Experiment Station.

WALTER J. WILLS has been appointed Chairman of the Department of Agricultural Industries, Southern Illinois University, effective July 1, 1957.

HARVEY S. WOODS has resigned from the Southern Illinois University School of Agriculture staff to accept a position as Head of the Department of Agriculture and Director of the Division of Agricultural Education at Illinois State Normal University effective September 1, 1957.

INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS

The tenth International Conference of Agricultural Economists will be held August 28 to September 8, 1958, at Mysore City in southern India. It will be followed by an inspection trip to study Indian agriculture and problems which will end at New Delhi on September 15.

The conference dates have been adjusted to permit attendance at the joint Canadian-American Farm Economics Associations which will close August 23.

Intent to attend the conference should be made known at once to reserve tentative passage via boat or air. More information on program, travel assistance and other details will follow.

Write H. C. M. Case, Secretary-Treasurer, ICAE, College of Agriculture, 305 Mumford Hall, Urbana, Illinois, or Joseph Ackerman, Farm Foundation, 600 South Michigan Ave., Chicago 5, Illinois.

LAND ECONOMICS INSTITUTE, UNIVERSITY OF ILLINOIS

A Land Economics Institute will be held at the University of Illinois during the Summer Session, June 17 to August 11, 1958. Courses and seminars in land economics and related subjects will be offered by staff from Illinois and from various institutions in the United States and abroad. Terminal courses carrying graduate credit are scheduled for two four-week sessions, June 17-July 13 and July 14-August 11. The general plan of the Institute has been developed by a national advisory committee associated with the land tenure committee of the Farm Foundation. For further information write Professor C. L. Stewart, Department of Agricultural Economics, University of Illinois, Urbana, Illinois.

PROGRAM OF AMERICAN FARM ECONOMIC ASSOCIATION AT JOINT SOCIAL SCIENCE ASSOCIATION MEETINGS IN PHILADELPHIA, PENNSYLVANIA, DECEMBER, 28-30, 1957

December 28—9:30 a.m.

ECONOMETRIC RESEARCH IN AGRICULTURE I
(Joint with Econometric Society)

Chairman: Walter H. Ebling, Wis. Agricultural Statistician

Input-Output Studies of Regional Differentials in Technological Change in Agriculture—
Vernon Ruttan, Purdue University
Thomas T. Stout, Purdue University

Better Basic Data for Agriculture—How Can the Needs be Met?—
Murray R. Benedict, University of California
George M. Kuznets, University of California

Discussants: George G. Judge, Okla. State University; Kenneth L. Bachman, Agricultural Research Service, U. S. Department of Agriculture

2:00 p.m.

A DECADE OF GENERAL AGREEMENT ON TARIFFS AND TRADE (GATT)

Chairman: John H. Davis, Harvard University

GATT a Cohesive Influence in the Free World—
John Leddy, U. S. Department of State

Synthesis of Trade and Agricultural Policies in GATT—
Robert B. Schwenger, Foreign Agricultural Service, U. S. Dept. of Agriculture

Discussants: Oscar Zaglitz, Foreign Agricultural Service, U. S. Dept. of Agriculture; Ernest Baugham, Federal Reserve Bank, Chicago; one to be announced.

8:00 p.m.

AFEA EXECUTIVE COMMITTEE MEETING

December 29—9:30 a.m.

AGRICULTURAL ADJUSTMENT RECONSIDERED
(Joint with American Economic Association)

Chairman: Earl Heady, Iowa State College

Changes in the Past 25 Years—
O. B. Jesness, University of Minnesota

Changes Needed in the Next 25 Years—
Marion Clawson, Resources for the Future

Discussants: William Jones, Stanford University; Kenneth Robinson, Cornell University; Hugh L. Stewart, Agricultural Research Service, U. S. Dept. of Agriculture

2:00 p.m.

VERTICAL INTEGRATION IN AGRICULTURAL MARKETING
(Joint with American Marketing Association)

Chairman: Ray A. Goldberg, Moorhead Seed and Grain Co.

Bases and Bounds for Integration of Firms and Functions—
M. A. Adelman, Massachusetts Institute of Technology

Relevant Management Decisions—
T. G. Redman, Swift and Company

Procurement of Supplies for Retailing—
Paul Baumgart, Safeway Stores, Inc.

Farm Cooperative Activities—
Willard F. Muehler, University of Wisconsin

6:00 p.m.

AFEA DINNER

Address: Agriculture's Public Relations—Bushrod Allin, Agricultural Marketing Service, U. S. Dept. of Agriculture

December 30—9:30 a.m.

AGRICULTURAL PARITY
(Joint with American Economic Association)

Chairman: John D. Black, Harvard University

Parity Re-Examined—
O. V. Wells, Agricultural Marketing Service, U. S. Dept. of Agriculture

Parity Price, a Case Study: The Concept of a Solution to an Economic Problem—
Rutledge Vining, University of Virginia
Discussants: V. W. Bladen, University of Toronto; Two to be announced.

2:00 p.m.

ECONOMETRIC RESEARCH IN AGRICULTURE II
(Joint with Econometric Society)

Chairman: Richard Foote, Agricultural Marketing Service, U. S. Dept. of Agriculture

Farm Policy Implications of Recent Research on Optimal Storage Rules—
Robert Gustafson, University of Chicago

Distributed Lags in the Measurement of Long-run Supply and Demand Elasticities—
Marc Nerlove, Bethesda, Maryland
Discussants: Two to be announced.